**Study Report 2010-01**

# Impact of Game-Based Training on Classroom Learning Outcomes

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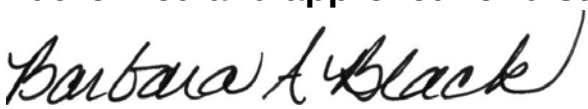

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The research presented here compares current training methods with the application of game-based training (GBT) for selected tasks in an institutional environment (classroom/garrison setting). This report focuses on the effectiveness of game-based simulations for training, as well as identification of strategies and methods for implementing such simulations. Multiple measures were obtained during two Advanced Leaders Courses: a biographical survey, multiple-choice pre-test and post-test, feedback questionnaires, hotwashes and group interviews, and observations during assessment events (e.g., terrain board testing, Close Combat Tactical Trainer exercises). Support for the effectiveness of GBT was found. The GBT group performed better on the post-test than the No-GBT group in one of the two courses. Both courses exhibited improvement from pre- to post-test, indicating that the course was effective in increasing Soldiers' knowledge. The research team received valuable feedback on how to best employ GBT in the courses studied as well as in other institutional programs.

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IMPACT OF GAME-BASED TRAINING ON CLASSROOM LEARNING OUTCOMES

## EXECUTIVE SUMMARY


Research Requirement:

The U.S. Army faces significant training challenges for the foreseeable future. Force transformation, the complexity of potential domestic and global missions, greater diversity of operational environments, and competing requirements for training resources are all key factors that impact training realities. Consequently, trainers are turning increasingly to innovative training methods that exploit low-cost, technology-based solutions. The research presented here compared current methods of instruction with the use of game-based technology in a classroom/ garrison environment, focusing on user acceptability and training effectiveness.

Procedure:

Game-based training (GBT) was evaluated in two Army Advanced Leaders Courses (19D–Cavalry Scout and 19K–Armor Crewman). Experimental participants conducted the mission execution stage of their practical exercises using desktop games (Virtual Battlespace 2 and DARWARS Ambush!), while control participants executed their practical exercise missions using terrain boards. Multiple measures were obtained by means of a biographical survey, a multiple-choice pre-test and post-test, feedback questionnaires, hotwashes and group interviews, and observations during current modes of course assessment (e.g., terrain board testing, Close Combat Tactical Trainer exercises). The multiple measures enabled assessment of several dimensions associated with the method of instruction.

Findings:

Support for the effectiveness of GBT was found. The experimental (GBT) group performed better on the post-test than the control (no-GBT) group in the 19K course, but not in the 19D course. Both groups in both courses showed improvement from pre-test to post-test, indicating that the lessons were effective in increasing Soldiers' knowledge. The feedback indicated that GBT "buy in" remains an issue for some Soldiers. Some of the perceived benefits of GBT remain difficult to assess, and further research will be necessary to develop appropriate measures of performance. The research team received valuable feedback on how to best employ GBT in the courses studied as well as other institutional programs.

Utilization and Dissemination of Findings:

Findings suggest there is value in incorporating GBT into schoolhouse programs for Soldiers. The capabilities of training games exploit varied tactical conditions to help Soldiers visualize the operational environment. However, courses incorporating GBT should not refer to the training as a "game." Training developers, trainers, and researchers can use the findings and lessons learned to create and implement instructional methods and programs that leverage the benefits of GBT.

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# IMPACT OF GAME-BASED TRAINING ON CLASSROOM LEARNING OUTCOMES

## Introduction

The U.S. Army faces significant training challenges, now and in the years ahead. Some of these challenges involve the persistently high operational tempo, the Army Force Generation (ARFORGEN) process, and deployment pressures on training requirements and time. Transformation of the Army structure, the complexity of potential domestic and global missions, greater diversity of operational environments, and competing requirements for training resources are all key factors that impact current and future training realities. Consequently, trainers are turning increasingly to emerging technologies and innovative training methods to exploit low-cost, technology-based solutions to rapidly fill critical training gaps and increase the impact and effectiveness of training for our Soldiers in a time of persistent war.

The military (and government, in general) is facing ever more complicated problems that require training, rehearsal and experimentation solutions that are more sophisticated and flexible than ever. Government organizations have therefore increased and accelerated funding to investigate, develop and procure innovative solutions to these problems. The use of relatively low-cost, commercial off-the-shelf (COTS) capabilities, including game-based technologies, offers one promising solution to those problems.

Experts in the fields of training technology and education have been investigating the benefits of technology-based solutions for years, including game-based training (GBT). In a review of the literature, we found that many researchers agree that technology-based approaches can be effective if used appropriately. However, while there is extensive information on the broader subject, there is a lack of sound empirical evidence, based on objective measures of performance, to assist training managers and Army leaders in making decisions regarding GBT.

The U.S. Army must quickly train a large number of Soldiers within a complex organization in a context where they must work together. Currently, Soldiers are trained using games for a wide range of skills including teamwork, strategy, and how to operate costly equipment (Prensky, 2007). According to Prensky, the benefits of game-based learning may include lower cost, better motivation of Soldiers, and greater operational relevance. Games can also provide high-fidelity realism and practice in competitive situations.

### *Background*

Hays (2005), describes several definitions and categorizations of games in a literature review on the effectiveness of games. For example, the “folk model” includes games of skill (puzzle games, instructional games), games of chance (card games), games of strategy (chess), and simulation games (role-playing games, video games). Other taxonomies organize games by a variety of conceptual features (see Hays, 2005; Prensky, 2001). Björk and Holopainen (2003) categorize games by four overlapping conceptual groups: the overall activity of the game, the boundary components of the game, the temporal components of the game, and the objective components of the game. The focus of the research presented here is on games that can be used for training and instruction.

*Terminology*

The terms *games* and *simulations* are often used interchangeably in the literature (Hays, 2005). However, Prensky (2001) notes that simulations are not necessarily games. Structural elements such as rules, goals, challenges, and competition distinguish simulations that take the form of games. Below are a few definitions used in the GBT literature:

- Game: "An artificially constructed, competitive activity with a specific goal, a set of rules and constraints that is located in a specific context" (Hays, 2005, p. 15).

- Simulation: A method for implementing a model over time; any representation or imitation of reality, to include environment, facilities, equipment, mechanical and maneuver operations, motion, role playing, leadership, etc.; the representation of salient features, operation, or environment of a system, subsystem, or scenario (Department of the Army, 2004).

- Game-based simulation: A computer-based system that enables leaders and team members to realistically practice the cognitive and decision making skills they will need in the real world (Roman & Brown, 2009).

- Simulator: (1) A device, computer program, or system that performs simulation. (2) For training, a device that duplicates the essential features of a task situation and provides for direct practice. (3) A physical model or emulation of a weapon system, set of weapon systems, or piece of equipment which endeavors to replicate some major aspect of the equipment's operation (Department of the Army, 2004).

- War game: A simulation game in which participants seek to achieve a specified military objective given pre-established resources and constraints; for example, a simulation in which participants make battlefield decisions and a computer determines the results of those decisions (U.S. Army Modeling and Simulation Office, 2010).

Desktop games such as Virtual Battlespace 2 (VBS2) fall under the military GBT umbrella. According to Bohemia Interactive Australia (2008), VBS2 is a fully interactive, COTS, three-dimensional training suite that provides a high-fidelity synthetic environment suitable for a wide range of military training and experimentation purposes. The software is easily deployed on laptops or desktops over a local network or the Internet. It offers large, realistic terrain databases and the ability to operate a host of land, sea, and air vehicles/weapons. While operating in VBS2, a participant views the virtual environment from the first-person perspective and is able to move, interact and operate as he would in real life.

*Effectiveness of Game-Based Training*

Numerous aspects and types of GBT have been investigated and put into practice in a variety of fields including business (Leger, 2006), education (Dickey, 2007; Dondi & Moretti, 2007; Jong, Shang, Lee, & Lee, 2008) and the military (Beal, 2007, 2009; Lampton et al., 1995; Lampton, Riley, Kaber, Sheik-Nainar, & Endsley, 2006; Mastaglio, Peterson, & Williams, 2004; Northrop Grumman Technical Services, 2008). However, the existing body of literature on GBT has not revealed a consistent effect of GBT on learning. Based on a review of instructional gaming literature, Hays (2005) cautioned that the empirical research yielded inconsistent results regarding use and effectiveness. In some studies, games were shown to be an effective method of training while in others they were not. One reason for the inconsistency may be that "too much of the empirical research on instructional games contains methodological problems (e.g., experimental confounds) that make it difficult to draw valid conclusions about the effectiveness of the games" (Hays, 2005, p. 43). Hays' review led to the following conclusions:

1. The empirical research on the effectiveness of instructional games is fragmented. The literature includes research on different tasks, age groups, and types of games. It is also filled with ill defined terms and plagued with methodological flaws.
2. Although research has shown that some games can provide effective learning for a variety of learners for different tasks (e.g., math, electronics, economics), this does not tell us whether to use a game for a specific instructional task. We should not generalize from research on the effectiveness of one game in one learning area for one group of learners to all games in all learning areas for all learners.
3. There is no evidence to indicate that games are the preferred instructional method in all situations.
4. Instructional games should be embedded in programs that include debriefing and feedback so the learners understand what happened in the game and how the events support the instructional objectives.
5. Instructional support to help learners understand how to use the game increases the effectiveness of the learning experience by allowing learners to focus on the instructional information rather than the requirements of the game (p. 53).

Despite the lack of consistent results in the empirical literature, Prensky (2007) suggests the military has embraced GBT "because it works" and that PC-based games can be effectively used for several training purposes. Research has demonstrated that specific skills can be trained with PC-based games (e.g., Rieber, 1996; Sims & Mayer, 2002), while other research has shown that training games can teach generalized skills like trouble shooting (Knerr, Simutis, & Johnson, 1979) and visual attention (Gopher, Weil, & Bareket, 1994; Green & Bavelier, 2003).

*Benefits of Game-Based Training*

In order for the Army to expend the resources to develop and implement GBT, it must be able to point to benefits relative to traditional training methods. Prensky (2001) suggests the benefits of GBT include lower cost, increased motivation of Soldiers, and greater operational relevance. Each of these will be addressed in turn.

Simulators are cheaper than operational equipment, an advantage that applies especially to aircraft (Hays, Jacobs, Prince, & Salas 1992). However, the initial cost of creating and evaluating the effectiveness of a game-based simulation can be substantial. For example, the U.S. Army invested considerable resources into implementing CCTT to provide state-of-the-art virtual training for team and collective training (Mastaglio et al., 2004). The CCTT allows users to collaborate with supporting units, such as aviation and air defense artillery, and to train in a variety of weather conditions (U.S. Army Program Executive Office for Simulation, Training, and Instrumentation, 2010). Once the training simulation has been established, the cost of training in a simulated battlefield is less than it would be using actual equipment on training ranges. In comparison to both live training and virtual simulation, GBT platforms are the more cost-effective option. For example, the multi-player, internet-based, tank game Spearhead II trains crews on artillery fire control and simulates mobility and combat interactions for 25 cents an hour per player (Erwin, 2000). Dome-based simulators with a motion-base and wrap-around imagery cost $5,000 to $10,000 to operate for each hour of useful training (Erwin, 2000).

Several studies support the notion that GBT increases learners' motivation. Massively multiple online role-playing games (MMORPGs) are synthetic arenas where players interact, collaborate, and strategize with others. The nature of MMORPGs challenges players to think critically and plan ahead, while promoting intrinsic motivation through choice, control, collaboration, challenge and achievement (Dickey, 2007). Using games as instructional tools can increase motivation to learn by more fully engaging students (Vogel, Greenwood-Ericksen, Cannon-Bowers, & Bowers, 2006). These findings are evidenced by America's Army, a game developed as a recruiting tool to inform the eligible population about military service as a Soldier (http://www.americasarmy.com). The game is a PC-based first-person-perspective game where players go through virtual basic training and then complete online military missions as part of a team. As evidence of the game's motivational allure, figures posted on the website indicate there are over 10 million registered players, with 5.4 million having completed basic training.

Regarding operational relevance, preparing small teams of dismounted infantry for urban operations is one of the greatest military training challenges today (Lampton, Clark, & Knerr, 2003), and GBT "supports small unit (fire team, squad, and platoon) training, mission rehearsal, and explorations and evaluation of potential changes in doctrine, organizations, equipment, and Soldier characteristics" (Lampton et al., 2006, p.1). It also imposes real-time pacing, vehicle and weapon operating demands, movement and maneuver activities, crew interaction, command and control demands, terrain complexities, and a battlefield environment rich in visual and audio cues. The venue compels Soldiers to apply their tactical knowledge under dynamic conditions rather than the static environment put forth by a textbook.

### *Technical Objectives*

This project aimed to provide decision makers empirical data they can use to make sound procurement and training decisions. The study involved collaborative efforts between the U.S. Army Research Institute (ARI), the U.S. Army Training and Doctrine Command (TRADOC) Capability Manager for Gaming, and the U.S. Army Armor Center (USAARMC). The research focused on determining the effectiveness of using GBT when compared with traditional (i.e., current) teaching methods and identifying appropriate ways of integrating GBT into existing

courses of instruction. The effort targeted the institutional training environment (i.e., classroom/ garrison setting) at Fort Knox, Kentucky. Within specific courses of interest, the strategic approach called for selecting existing practical exercises (PEs) as research-focused venues for implementing the chosen PC-based game. The technical objectives included the following:

- Design and implement research to determine the effectiveness of using GBT when compared to traditional (i.e., current) teaching methods.
- Develop, test and refine new GBT materials to replace existing materials for the research-focused PEs.
- Identify strategies and methods for implementing GBT in institutional courses.

## Method

### *General Aspects*

#### *Population Studied*

The students in two Army Advanced Leaders Courses (ALCs)—the Cavalry Scout (19D) and Armor Crewman (19K) courses—defined the population of interest. Both of these courses are part of the noncommissioned officer (NCO) leadership curriculum taught by the NCO Academy (NCOA) at Fort Knox. They are designed to meet the demands of today's mounted units, such as preparing Soldiers for greater decision making and leadership responsibilities required in the current operational environment. This is achieved by developing the fundamental tactical and technical skills and adaptive leader qualities needed to face current and future operations across the spectrum of conflict. In the ALC, the focus is on preparing Soldiers to move up from the section and squad level to the platoon leadership level. It reinforces and enhances military occupational specialty (MOS) technical skills, while also preparing the NCO to advance to the next level.

The 19D and 19K ALCs were selected for the research because they each included PEs as part of the program of instruction. Both courses lasted seven weeks, with 35 days of training that covered 17 lessons in the 19D course and 16 lessons in the 19K course. Each lesson included classroom lectures and discussions as well as terrain board testing, and some lessons included a PE with an after action review (AAR). Also, at the time of the investigation the courses had adopted both desktop GBT exercises using DARWARS Ambush! and immersive simulation exercises using CCTT. Thus, each course lent itself to observing and researching multiple teaching techniques, with and without GBT.

The students and instructors in two iterations of each course comprised the sampling domain. Within each course the students were organized into small groups (generally 10-15 students each), with each group assigned a primary and assistant instructor. The students in a given group performed their instructional activities together throughout the course, unless attrition necessitated regrouping to preserve the desired instructor-to-student ratio. The number of groups available for sampling was determined by the total enrollment of a given course.

*Gaming Platform*

The research team selected VBS2 as the primary gaming platform of interest because of its high fidelity and robust functionality, in addition to the fact that it is approved for use, widely distributed, and supported in both Army training institutions and units. The VBS2 platform provides a full range of weaponry, the ability to conduct mounted and dismounted operations, multiple terrain options, tactical realism, playback functions suitable for AARs, and adaptive environments deemed desirable by the research team. The VBS2 platform supports multiple players which was desirable given that ALC students work together in groups of 10-15 each. Students in the GBT groups also used DARWARS Ambush! during their training, but after the primary data collection period.

*Facilities*

The ALC building contained traditional classrooms, allocated between the 19D and 19K classes. Each classroom was basically the same, with seating for up to 16 students (see Figure 1). Tables were arranged in a "U" shape with a terrain board in the center. A ceiling-mounted projector could display imagery (e.g., slides) on a large screen at the front of the classroom.

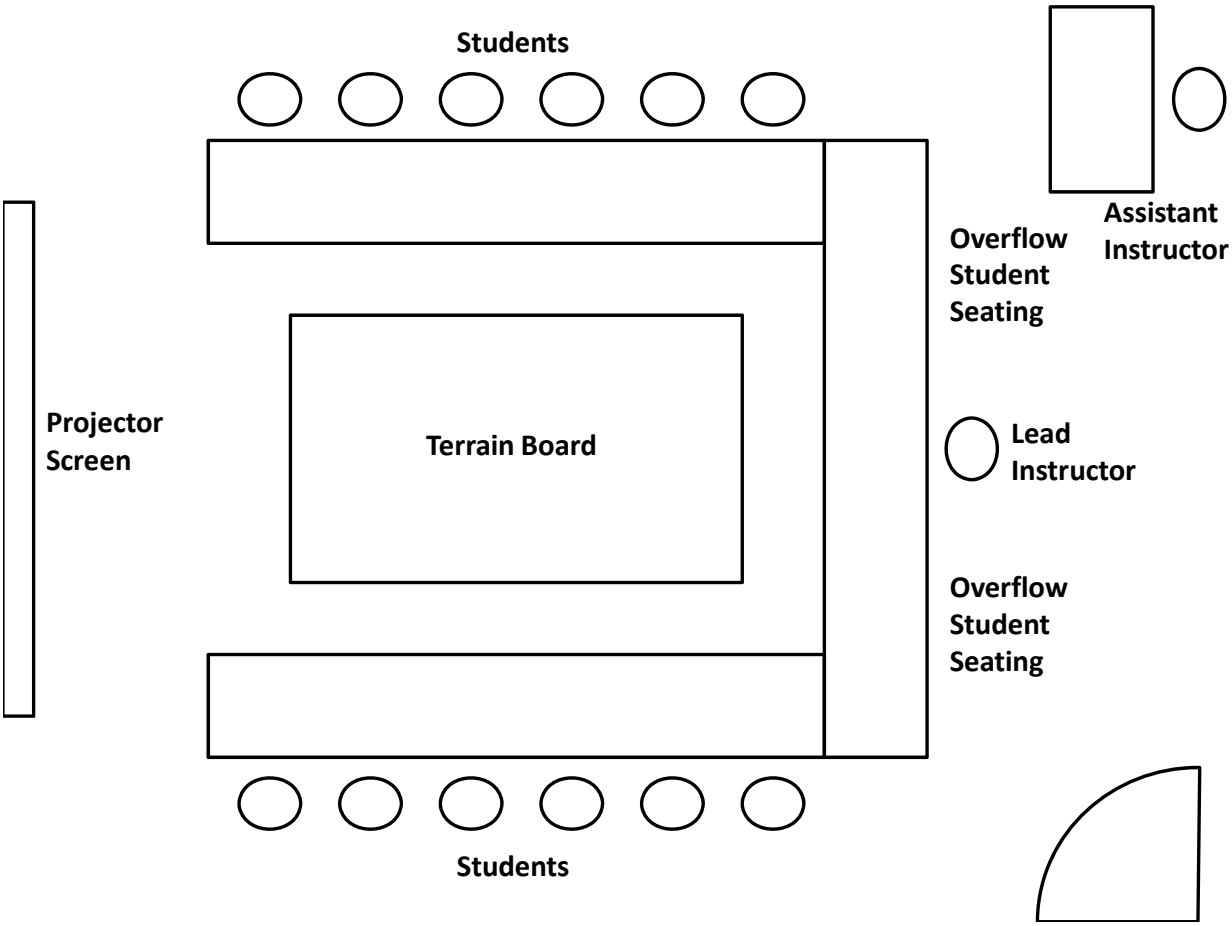


Figure 1. Diagram of a traditional ALC classroom.

A GBT laboratory was constructed in one of the larger classrooms (see Figure 2). The laboratory contained 15 laptop workstations plus an instructor's station equipped with a sound system. The workstations were placed in a "U" shape with student stations lining the tables and the instructor's station located to one side of the horseshoe's head. Each laptop was loaded with VBS2 software, Communications Net Radio Simulator (CNR-SIM) to support radio traffic, Communications Net Radio Logger (CNR-LOG) to record radio traffic for AAR purposes, a headset equipped with microphone, and a laser "gaming" mouse. The laboratory was networked via CAT6 Ethernet and a gigabit router to facilitate high-speed data transfer. The hardware and software configuration closely mimicked Program Executive Office for Simulation, Training, & Instrumentation (PEO-STRI) fielded systems. A ceiling-mounted projector was connected to the instructor's station so students could view instructor actions as he demonstrated on his machine, or they could watch the VBS2 recording that was being replayed during the AAR.

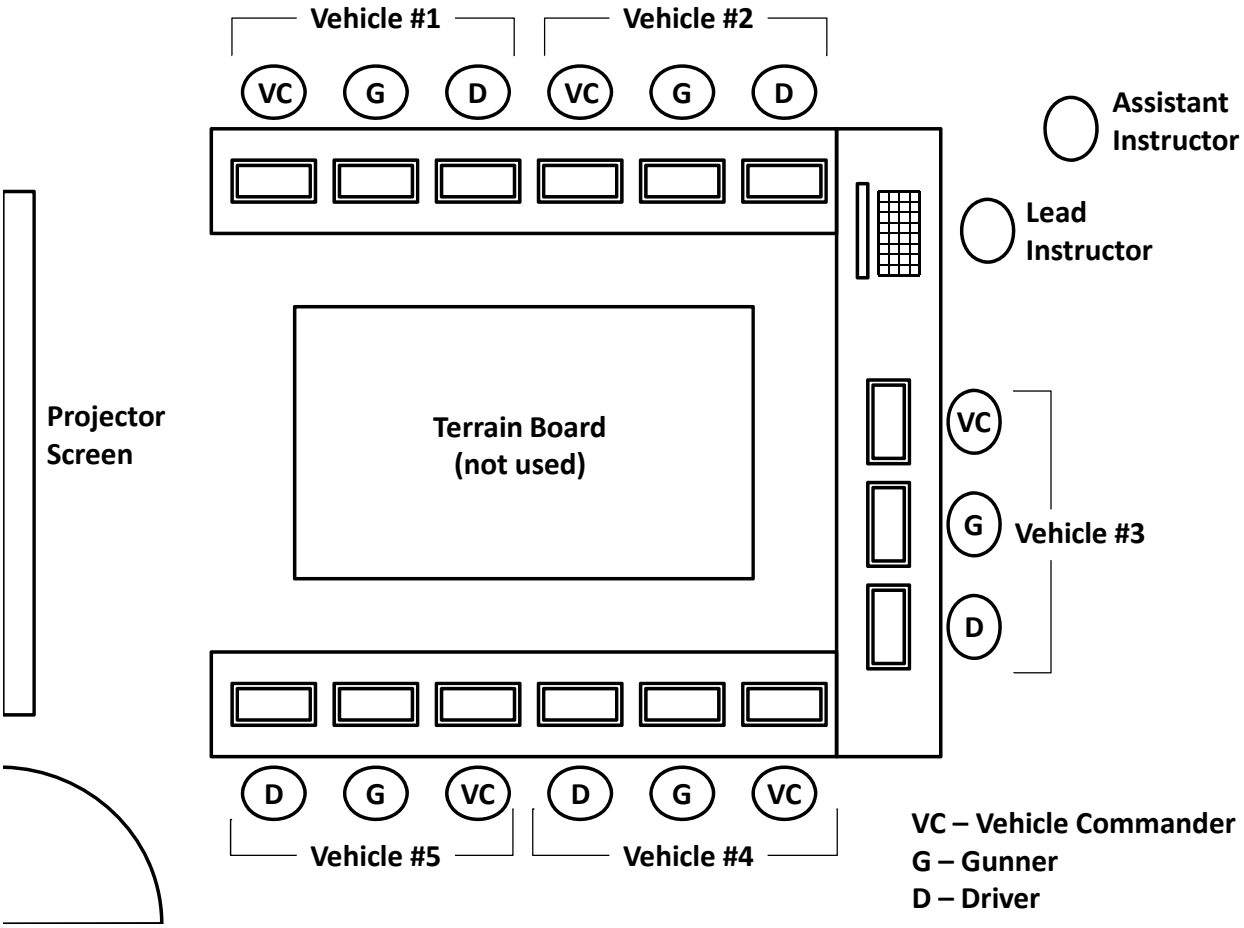


Figure 2. Diagram of VBS2 laboratory.

*Scenario Conversion*

From the ALC lessons that included a PE, one PE was selected for special research attention: Route Reconnaissance with an Obstacle from the 19D course, and Vehicle Tactical

Movement from the 19K course. Each research-focused PE provided an opportunity to inject VBS2 technology into the program of instruction. The two PEs were selected based on several criteria: (a) compatibility with VBS2 capabilities, (b) placement in the course timeline, (c) realistic option for dismounted actions, and (d) mission complexity. Both research-focused PEs occurred approximately one-third of the way through the course. The research team felt this would allow students to become comfortable with the course, yet avoid strong influence of cumulative course learning. Each PE included several stages—classroom lecture, group discussion, mission preparation, mission execution, and AAR. Simulations were constructed to conduct the mission execution stage of a PE.

For each research-focused PE, existing mission execution materials were converted for VBS2 implementation. The start point for the conversion was a set of DARWARS Ambush! materials for the route reconnaissance PE and a set of terrain board materials for the vehicle tactical movement PE. During the conversion, the research team followed TRADOC Regulation 350-70 (Department of the Army, 1999) as closely as possible. Requisite VBS2 files were constructed for each mission, as well as a practice mission used for train-up. The converted PE materials underwent several cycles of development, vetting by instructors and subject matter experts (SMEs), and subsequent refinement to ensure fidelity and doctrinal accuracy.

### *Experimental Parameters*

The research aimed to gather qualitative and quantitative data capable of supporting sound procurement and training decisions. To achieve this goal, the team attempted to assess the effectiveness of GBT as one of the ALC instructional methods. Accordingly, the investigators manipulated the method of PE execution in each course, and collected a variety of data at several points in time. A mixed experimental design was employed for the written knowledge tests. Treatment condition—terrain board (No-GBT) vs. GBT—served as the between-subjects independent variable, while time of testing (pre-test vs. post-test) served as the within-subjects independent variable. Test score served as the dependent measure. Students in the control condition (No-GBT) were scheduled to execute all of their PE missions using a terrain board. Students in the experimental condition (GBT) were slated to execute one PE mission using VBS2 and the remaining PE missions using a mixture of DARWARS Ambush! and terrain board, as dictated by the program of instruction. Observational data and written and verbal feedback were gathered to illuminate instructor and student reactions and opinions, and to identify opportunities for enhancing learning through GBT.

### *Participants*

A total of 22 course instructors provided data for the research (see Table 1). Most of the data were obtained during the first round of data collection with 13 instructors from the 19D course and 5 from the 19K course. During the second round several of the instructors had participated in round one, but four 19D instructors provided feedback data because they had not contributed previously. The sample sizes varied within and across courses due to instructor availability and selection. For example, some instructors were off duty when data were collected, and only a subset of instructors was assigned to train the students in the experimental and control conditions.

A total of 148 students provided limited background data (see Table 1). In the first round of data collection, 55 students from the 19D course and 23 students from the 19K course provided data, while during the second round 41 students from the 19D course and 29 students from the 19K course provided data. From the 148 students enrolled in the courses, a subset of 94 students was selected to participate in the study. All students in the 19K courses (four groups) were assigned by group to the experimental or control condition. In the 19D courses, four groups were selected for assignment to the experimental and control conditions through group matching based on biographical data (especially rank and years of relevant service). The assignment process ignored pre-test scores. Only a subset of student participants provided data through the entire course due to selection and, to a lesser extent, attrition. During the first round of data collection in the 19K course, three students were lost due to attrition—one for physical training failure, one for academic failure, and one for personal reasons.

Table 1
*Group Composition for Instructors and Students, by Course*

| Course | Role | Number of Participants | Rank Mix | Average Length of Service (mos) |
|---|---|---|---|---|
| 19D (1) | Instructor<br>Student | 13<br>55 | 13-SSG<br>11-SGT, 44-SSG | 132.92<br>101.40 |
| 19D (2) | Instructor<br>Student | 4<br>41 | NA<br>9-SGT, 32-SSG | NA<br>90.90 |
| 19K (1) | Instructor<br>Student | 5<br>23 | 4-SSG, 1-SFC<br>7-SGT, 16-SSG | 179.20<br>81.65 |
| 19K (2) | Instructor<br>Student | 0<br>29 | NA<br>25-SGT, 4-SSG | NA<br>93.86 |

*Note*. (1) - represents first round of data collection; (2) - represents second round of data collection; NA - denotes no data available. The data reported here reflect all students enrolled, and all available instructors, prior to selecting groups for experimental and control conditions.

For the student biographical data, a multivariate analysis of variance was conducted to examine whether any significant differences existed between treatment condition (GBT vs. No-GBT) and data collection round (first vs. second). There were no statistically significant main effects on any of the measures for either treatment condition or data collection round ($p > .05$). Thus, to simplify presentation, student biographical data were collapsed across rounds for the 19D and 19K experimental and control conditions. Table 2 presents the relevant data for the students in both courses.

*Materials*

To support comprehensive evaluation, multiple performance and feedback measures were selected and translated into standard data collection instruments, as appropriate. The selection of measures was based on the inherent strengths and weakness associated with each parameter, and the limitations associated with conducting research in an institutional environment. For example, terrain board exams offered insight into a student's understanding of the course material and allowed him to apply what he had learned under varying tactical conditions of mission, enemy,

terrain and weather, troops, time and civil considerations (METT-TC). However, the exam procedures were not executed in real time during a terrain board exercise, and command and control remained very artificial. In addition, testing procedures and scoring rules for the exams were constrained by each course's prescribed program. Finally, terrain board exercise scores were not well suited for identifying methods and strategies for implementing game-based simulations. Table 3 summarizes the strengths and weaknesses of the various performance and feedback measures adopted by the research team for the investigation. Table 4 presents a list of the instruments used for data collection.

Table 2
*Student Biographical Parameters, by Course and Treatment Condition*

| Biographical Measure | Course | | | | | |
|---|---|---|---|---|---|---|
| | 19D | | | 19K | | |
| | Control | Experimental | *p* | Control | Experimental | *p* |
| Number of Students | 20 | 21 | | 24 | 28 | |
| Rank | SGT-10<br>SSG-10 | SGT-5<br>SSG-16 | | SGT-10<br>SSG-14 | SGT-17<br>SSG-11 | |
| Length of Service (mos) | 101.50<br>(30.30) | 99.86<br>(39.69) | .92 | 86.58<br>(25.73) | 86.50<br>(15.32) | .99 |
| Deployment Experience (mos) | 28.90<br>(15.15) | 24.38<br>(12.06) | .30 | 23.33<br>(10.70) | 25.14<br>(12.07) | .57 |
| Route Recon Experience (Rating, 0 to 3) | 2.10<br>(.72) | 1.95<br>(.80) | .54 | 2.29<br>(.69) | 2.04<br>(.88) | .26 |
| Veh Tact Mvmt Experience (Rating, 0 to 3) | 2.25<br>(.72) | 2.38<br>(.50) | .50 | 2.17<br>(.69) | 2.43<br>(.63) | .25 |
| PE Experience with DARWARS Ambush! (Rating, 1 to 5) | 1.60<br>(.88) | 1.52<br>(.81) | .78 | 1.70<br>(.86) | 1.79<br>(.96) | .76 |
| PE Experience with Terrain Boards (Rating, 1 to 5) | 2.35<br>(1.04) | 2.90<br>(.77) | .06 | 3.08<br>(.93) | 2.68<br>(1.19) | .18 |
| Use of Terrain Boards in Training/Operations (Rating, 1 to 5) | 2.85<br>(.99) | 3.29<br>(.90) | .15 | 3.29<br>(.91) | 3.11<br>(1.17) | .53 |
| Deployment Relevance to ALC (Rating, 1 to 5) | 3.40<br>(.68) | 3.57<br>(.60) | .40 | 3.54<br>(.98) | 3.46<br>(.84) | .76 |

*Note*. (a) Figures in parentheses are standard deviations. (b) For all ratings, lower values correspond to less experience and higher ratings to more experience.

*Knowledge tests.* To measure the expected improvement in knowledge and skills associated with the research-focused PEs, the team developed a pair of paper-and-pencil tests for each course. The multiple-choice pre- and post-tests were based on Army doctrine directly related to course outcomes in the context of reconnaissance and scout platoons (Department of the Army, 2009) and tank platoons (Department of the Army, 2007). The 19K tests can be seen in Appendixes C and F. The questions were carefully constructed from the field manuals by

SMEs and reviewed by research team members with over 20 years of experience in testing and measurement. The research team was careful to build tests that would not produce floor or ceiling effects—being neither too easy nor too hard. The parallel versions of each test were subsequently vetted by a separate group of SMEs and revised according to the feedback. Then SMEs from the Armor School and NCOA cadre reviewed the tests and provided feedback. The positive feedback from the SMEs and cadre members indicated that each written test fairly and adequately represented the course material, with comparable difficulty between the pre- and post-test versions.

Table 3
*Measurement Venues and Associated Strengths and Weaknesses*

| Measurement Venue | Strengths | Weaknesses |
|---|---|---|
| Terrain Board Exams | • Demonstration of procedural knowledge<br>• Objective grading (checklist)<br>• Familiarity among target audience<br>• Suitability for comparison between GBT and traditional methods | • Ceiling effects<br>• Lack of real-time dynamics<br>• Omission of communication skills<br>• Limited relevance to programmatic questions |
| CCTT Tactical Exercises | • Demonstration of applied knowledge and communication skills<br>• Teamwork performance environment<br>• Tactical realism<br>• Real-time dynamics | • Lack of objective scoring standards<br>• Difficulty measuring individual performance<br>• Difficulty attributing effects<br>• High technical support overhead |
| Written Tests | • Demonstration of factual and procedural knowledge and decision making skills<br>• Objective, quantitative scoring<br>• Suitability for comparison between GBT and traditional methods | • Lack of real-time dynamics<br>• Omission of communication skills<br>• Psychometric limitations<br>• Limited relevance to programmatic questions |
| Desktop Gaming Exercises (DARWARS Ambush!, VBS2) | • Demonstration of procedural, communication, and decision making skills<br>• Real-time dynamics<br>• Suitability for insights re: implementing GBT methods and strategies | • Workstation train-up requirements<br>• Dependence on computer skills<br>• Lack of established metrics<br>• Low buy-in among target audience<br>• Technical support overhead |
| Written and Verbal Feedback | • Capture of opinions and suggestions<br>• Suitability for quantitative ratings<br>• Suitability for open-ended queries<br>• Suitability for insights re: implementing GBT methods and strategies | • Susceptibility to multi-source bias<br>• Logistical/administrative challenges<br>• Low suitability for performance-based comparisons<br>• Possible interpretive difficulties |
| Third-Party Observation | • Knowledgeable outsider's perspective<br>• Illumination of procedural detail<br>• Flexibility of discovery process<br>• Suitability for insights re: programmatic and implementation issues | • Susceptibility to observer bias<br>• Difficulty ensuring consistency across observers<br>• Low suitability for performance-based comparisons |

*Feedback instruments and observation protocols.* The researchers created the data collection instruments following Spickard's (2005) recommendations for constructing survey

protocols. Questions were created to (a) probe for substantive differences between traditional and GBT methods, (b) elicit comments regarding the costs and benefits of using GBT, and (c) identify opportunities to employ the technology. Questionnaires and surveys utilized rating items (Likert-type scales), open-ended questions, and global write-in prompts (see Appendixes E and G for representative questionnaires). Observation protocols were developed to capture key training events and procedures, such as frequency and type of instructor-student interaction, perceived effects of PE training on student learning, and student performance. An example observer's guide appears in Appendix D.

Table 4
*Data Collection Instruments Used*

| Instrument | Purpose |
|---|---|
| Biographical Survey (see Appendix B) | Characterize participants to support assignment process and interpretation of findings |
| Written Pre-Test (separate versions for 19D and 19K) (see Appendix C) | Establish starting baseline of student knowledge regarding specific research-focused PEs |
| Written Post-Test (separate versions for 19D and 19K) (see Appendix F) | Quantify improvement in student knowledge regarding specific research-focused PEs |
| Observer's Guide – Practical Exercises (see Appendix D) | Structure observation activities to capture systematic information and insights re: GBT employment, benefits and limitations |
| Instructor Feedback Questionnaire – After Practical Exercise | Capture written reactions and impressions re: VBS2 or terrain board training while fresh |
| Student Feedback Questionnaire – After Practical Exercise (see Appendix E) | Capture written reactions and impressions re: VBS2 or terrain board training while fresh |
| Instructor Interview Protocol – Post PE | Supplement written feedback while experience in research-focused PE was fresh |
| Student Hotwash Protocol – Post PE | Supplement written feedback while experience in research-focused PE was fresh |
| Observer's Guide – Terrain Board Exams (separate 19D and 19K versions) | Structure observation activities to capture systematic information and insights re: student proficiency and assessment method |
| Observer's Guide – CCTT | Examine how method of PE execution may influence collective performance |
| Instructor Feedback Questionnaire – End of Course (EOC) | Capture reflective opinions and ideas re: VBS2 or terrain board training |
| Student Feedback Questionnaire – End of Course (see Appendix G) | Capture reflective opinions and ideas re: VBS2 or terrain board training |
| Instructor Interview Protocol – End of Course | Supplement written feedback by exploiting reflection and critical thought |
| Student Interview Protocol – End of Course | Supplement written feedback by exploiting reflection and critical thought |

*Miscellaneous materials*. To facilitate VBS2 workstation operations, the research team developed train-up materials including a PowerPoint slide set and keyboard crib sheet. As a

research management tool, the team prepared a Data Collection, Management and Analysis Plan to guide the evaluation efforts. The plan specified data requirements, data collection instruments, schedule of events, collection and management procedures, and analysis approach.

*Procedure*

To test the effectiveness of GBT, the experimental groups conducted the mission execution stage of their PEs using VBS2 and DARWARS Ambush!, while the control groups executed their PE missions using terrain boards. The assigned ALC instructors managed the PEs as part of the established program of instruction. Prior to the start of the first round of data collection, the research team's primary VBS2 expert trained the pool of 19D and 19K instructors (in separate groups) on workstation operations, VBS2-supported tactical communication, and game-specific exercise control.

At several points throughout the course, researchers collected multi-dimensional data in accordance with the Data Collection, Management and Analysis Plan. Multiple measures were collected by administering the biographical survey, multiple-choice pre-test and post-test, feedback questionnaires, hotwashes and interviews in group mode (except for one-on-one interviews with occasional instructors). In addition, research team SMEs observed key events (research-focused PEs, culminating terrain board exams, CCTT exercises) using tailored observer guides. The schedule of research events is displayed in Table 5.

Table 5
*Schedule of Research Events*

| Day of Course | Researcher Activities |
|---|---|
| Day 1 | Administered biographical survey and written pre-test |
| Day 2 | Selected and assigned groups to treatment conditions |
| Day 10 | 19D Course: observed PE, administered written post-test and feedback questionnaires, conducted hotwash and interview |
| Day 13 | 19K Course: observed PE, administered written post-test and feedback questionnaires, conducted hotwash and interview |
| Days 26-27 | Observed culminating terrain board exams |
| Days 27-33 | Observed CCTT exercises |
| Days 34-35 | Conducted end-of-course feedback surveys and interviews |

On the first day of the course the students completed the biographical survey and the pre-test. The first-round instructors also completed the biographical questionnaire at this time. Within a day the research team assigned student groups to the treatment conditions. In each round of data collection, the two groups in the 19K courses were assigned randomly to the experimental condition (GBT) or the control condition (No-GBT). From the groups enrolled in the 19D courses (six groups in round one, four groups in round two), two groups in each round were selected for comparability on biographical parameters and then assigned randomly to the experimental or control condition. As the students proceeded through the normal instructional events, research-specific data collection events (see Table 5) were inserted into the academic schedule.

During the first round of data collection, all of the students in the 19D control condition were reassigned to other groups due to the attrition-driven need to rebalance student groups. The scattering of the students from the control condition led to a de facto adjustment of group sizes. This occurred following the route reconnaissance PE, and the reassigned control participants subsequently received some GBT. Thus the data collected during and immediately following the route reconnaissance PE (see Day 10 in Table 5) were representative of the control condition as intended. It became more difficult to track these participants during the remainder of the course. As a result, the data collected at the end of the course (days 26-35 in Table 5) reflected a mixture of students from the control condition and students who were not assigned to either the experimental or control condition.

Prior to the first round of data collection, all available instructors received three full days of VBS2 training. One of the research team's VBS2 experts conducted this training in a layered approach: (a) basic VBS2 functions and tools, with practice exercises; (b) advanced functions such as tactical communication, exercise control, and AAR features, (c) creating, editing, and implementing mission-based scenarios, and (d) practical exercises with structured missions. In the latter stage, the instructors performed each mission multiple times, allowing each one to play the role of instructor, student, and artificial intelligence controller. Time limitations prevented training on handling system errors and crashes.

All experimental students received approximately 2 hr of practical training on VBS2 workstations, one day or less in advance of executing the research-focused PE. This train-up dealt mainly with vehicle, dismount, and weapons operations as well as command and control in the gaming environment. A VBS2 expert from the research team supported the instructor-led train-up, which relied on VBS2-embedded modules plus an abbreviated mission for operational practice. The group train-up was occasionally supplemented with individual tutoring.

An intact student group (10-15 participants) performed a given PE together, with the PE instructor leading the mission execution. The instructor served as trainer, coach, and company commander. Terrain board PEs were performed with one student (the designated platoon leader) describing his actions on the terrain board, as the remaining students observed. The instructor primarily interacted with the student leader as the mission unfolded. The terrain board mission execution typically lasted less than an hour. In the VBS2 PEs the instructor also doubled as the exercise controller, with on-site technical support provided by a simulation expert from the research team. Three students served as platoon leader and section leaders for the entire exercise. The rest of the students served as vehicle commanders, gunners and drivers. Each student worked at his own VBS2 workstation using the first-person or third-person view, as desired, and a mix of headsets and direct voice for tactical communication. The VBS2 mission execution typically lasted a couple of hours, with a re-run option implemented occasionally. In the DARWARS Ambush! PEs, mission execution resembled the conditions of the VBS2 exercises, with no technical support provided by the research team.

In both conditions, mission completion was followed by an AAR led by the instructor. The AAR in the No-GBT condition generally involved a summary of the teaching points by the instructor. In the GBT condition the AAR included a video/audio playback. Once the AAR for

a research-focused PE was completed, research team members administered the post-test (see example in Appendix F) to the students. They then administered feedback questionnaires (see example in Appendix E) to all participants. A researcher conducted a structured hotwash with the students as a group, then interviewed the instructor alone using an interview protocol. A companion researcher took notes during hotwashes and interviews.

Members of the research team observed the execution phase and AAR of every research-focused PE (reconnaissance of a route with obstacle for 19D, and vehicle tactical movement for 19K). Observation guides were used to assist researchers in recording desired information (see Appendix D for an example guide).

Upon completion of all scheduled lessons, individual students completed culminating terrain board exams during which investigators collected research-specific data. A tailored guide structured this data collection process. The researchers later observed CCTT exercises where students were organized as platoons operating in vehicle simulators. One student served as platoon leader, and four others as tank commanders. The remaining students worked as vehicle crewmen (drivers, gunners). The leadership roles were rotated from one CCTT exercise to the next. The students executed each mission with the leader issuing commands to the tank commanders and providing progress reports to the instructor. Missions ran until failure and were followed by an AAR, sometimes accompanied by video playback.

Near the end of the course, the students and instructors in separate groups filled out the end-of-course feedback survey (see example in Appendix G) and participated in interviews. The feedback groups contained only the instructors and students currently available, and the student groups often included some who had not been assigned to a treatment condition. The facilitator limited each structured interview to 45 min, during which time another researcher took notes.

## Results and Discussion

This section presents and discusses the results of the research efforts, including experimental artifacts and limitations encountered while testing in the institutional setting. Data analysis was performed using a mix of quantitative and qualitative techniques (Creswell, 2002). Quantitative measures included performance on written pre- and post-tests, frequency counts, and scaled ratings. The test scores were used to assess knowledge. The counts and ratings were used to measure perceptions of GBT. Qualitative measures included participants' spoken and written feedback on topics of interest. The feedback was recorded and categorized to represent the opinions, ideas, and insights of the target audience.

Each measure addressed a separate aspect of the materials and training methodology. The following topics will organize the presentation: Experimental Artifacts, Effects of GBT Assessed through Written Tests, Observational Data, Feedback Data, and Lessons Learned. Each of these will be addressed in turn.

### *Experimental Artifacts*

Experimental artifacts are unavoidable when conducting research in applied settings. Variables that can normally be controlled in an experimental setting are no longer under the control of the researchers. The current program of research was conducted in an applied setting where the research goals were secondary to the academic goals—providing quality instructorship and first-rate training to active-duty Soldiers. As a consequence, the course demands and the setting produced experimental artifacts. The reassignment of the first-round students in the 19D control condition, who were slated to receive no GBT exercises, resulted in those students participating in some GBT missions. Other students in the control condition may have received DARWARS Ambush! training in at least one PE (though not the research-focused PE).

Another limitation was the fact that students learned by several instructional methods throughout the ALC course. Lectures, group discussions, observation of other students, and AARs all contributed to student learning. Further, there were teaching style differences between instructors that could not be controlled for by matching or counterbalancing instructor assignments. There are likely strong and complex interactions between (a) performing a PE with or without GBT, (b) other learning opportunities and (c) instructor teaching style.

During the culminating terrain board exams and CCTT exercises, instructors were asked to provide numerical ratings of student performance based on a ten-point scale. Because the instructors were not accustomed to rating student performance according to such scales, scores were highly subjective and variable across instructors, limiting their sensitivity.

Instructor and student biases likely influenced the results in multiple ways. Some participants may have strongly preferred terrain board techniques due to familiarity and limited computer skills. Such biases may have been reinforced by the lack of opportunity to train instructors and students to an adequate level of VBS2 workstation proficiency. For example, due to time constraints, student VBS2 train-up was limited to approximately 2 hr. Researchers observing the VBS2 missions noted some frustration by participants resulting from their lack of workstation proficiency. Finally, notable peer influence was observed which likely affected individual performance and ratings in a negative direction. Several students voiced negative comments regarding GBT that seemed to originate from one or two Soldiers.

In sum, comparisons between GBT and terrain board methods must be viewed with caution, especially considering that no "pure" control group existed. Limited workstation training, preexisting biases and peer influence may all have affected participants' ratings. Altogether, these artifacts somewhat limit confidence in the findings reported.

### *Effects of GBT Assessed through Written Tests*

The pre-test (Appendix C contains an example) was given prior to any coursework, while the post-test (Appendix F) was administered after the AAR for the research-focused PE. The pre-test and post-test contained multiple-choice questions that asked the student to "circle the best answer" or "circle all that apply." Correct responses were weighted equally, receiving one point. Questions with multiple correct responses were scored for correct identifications and correct rejections. For example, Question 2 on the 19K pre-test asked students to "circle all that

apply" from items A through F. The correct items were A, D and F, and students earned one point for circling each of these items. Additionally, students could earn one point each for not circling items B, C, and E. Thus, the maximum score for Question 2 was six points. Using these scoring rules the maximum number of points per test were as follows: 19K pre-test – 44 points, 19K post-test – 35 points, 19D pre-test – 54 points, and 19D post-test – 51 points. All of the raw test scores were converted to percent correct to normalize the data.

Prior to performing inferential analysis, the data were reviewed for outliers or suspicious cases. The data for two control students from the second round of the 19D course were dropped from the analysis due to questionable post-test performance. The pre-test scores for both of these students (72% and 53% correct) were on par with their peers, but their post-test scores dropped to below/near chance (27% and 37%, respectively). Further, both students exhibited a response bias (e.g., circling "c" for most answers) and a failure to discriminate alternative answers (e.g., circling all or none of the answers for the "circling all that apply" questions). Across both courses, only these two students exhibited appreciably lower performance on the post-test.

The resulting percent correct data were subjected to mixed analysis of variance (ANOVA) using the Statistical Package for the Social Sciences (SPSS), with time of testing (pre-test vs. post-test) serving as a within-subjects variable and data collection round (round 1 vs. round 2) as a between-subjects variable. The data for the 19D and 19K courses were analyzed independently. The analysis indicated that scores increased significantly in the 19D and 19K courses from pre-test to post-test, $F(1, 34) = 29.75$, $\eta_p^2 = .47$, $\beta = 1.00$, and $F(1, 45) = 67.45$, $\eta_p^2 = .60$, $\beta = 1.00$, respectively (both $p$'s $< .001$). In both courses, students performed significantly better on the post-test than the pre-tests. However, no significant differences were found in the 19D and 19K courses according to data collection round, $F(1, 34) = 0.04$, $\eta_p^2 = .001$, $\beta = .06$, and $F(1, 45) = 0.39$, $\eta_p^2 = .008$, $\beta = .09$, respectively ($p = .84$ and $p = .54$). Since no differences were found according to data collection round, data from the two rounds were combined to increase the statistical power of the test of the treatment condition variable (GBT vs. No-GBT).

For the pre-test scores in both courses, no significant differences were found between the two treatment conditions. Average scores for both courses and treatment conditions appear in Table 6, along with standard deviations. In the 19K course, the GBT condition did not differ significantly from the No-GBT condition, as shown by $t(50) = 1.31$, $p = .20$, $d = .36$. A similar finding resulted for the 19D course, as revealed by $t(36) = .95$, $p = .35$, $d = .31$. These results indicate that the student assignment/selection process was effective in creating equivalent groups prior to treatment.

Table 6
*Average Student Scores (Percent Correct) on Knowledge Tests, by Course and Condition*

| | Course and Treatment Condition | | | |
|---|---|---|---|---|
| | 19D | | 19K | |
| Test Stage | GBT (n = 21) | No-GBT (n = 20) | GBT (n = 26/23) | No-GBT (n = 24) |
| Pre-test | 64.81 (10.05) | 61.79 (9.54) | 56.21 (10.91) | 52.54 (9.26) |
| Post-test | 69.66 (13.89) | 75.23 (8.63) | 72.67 (10.33) | 64.51 (10.81) |

*Note*. Figures in parentheses are standard deviations.

The effects of treatment condition (method of PE execution) varied across courses. In the 19K course, students in the GBT condition performed significantly better on the post-test when compared to students in the No-GBT condition, as evidenced by $t(47) = 2.69$, $p = .01$, $d = .77$. However, in the 19D course no significant difference was found on the post-test between students who received GBT and those in the No-GBT condition, as evidenced by $t(36) = 1.49$, $p = .15$, $d = .48$.

Overall, the results of the written tests suggest that student knowledge increased as a result of ALC instruction. In addition, there was evidence that GBT enhanced student knowledge. There are several candidate reasons why GBT produced significant differences in one course and not the other—differences between instructors, student factors (e.g., peer influence), contamination of the control condition in the 19D course, etc. Ultimately, given the experimental artifacts of this research, it is not possible to determine which factors contributed to finding the treatment effect in only the 19K course.

### *Observational Data*

Guided by structured protocols, researchers collected observational data during several events throughout the course including research-focused PEs, culminating terrain board exams, and CCTT exercises. These data were largely qualitative, with occasional quantitative measures of student performance. The purpose was to document current methods of instruction and assessment, discover unique contributions of GBT, recognize opportunities where GBT may benefit learning, and indentify enablers and obstacles in implementing GBT.

By the very nature of the ALC courses studied, primary instruction during PEs focused on a single student (leading a platoon) and perhaps 2-3 other students (leading a section or commanding a tank). The rest of the students served in subordinate roles where they might learn from observing the actions of the student leaders and the instructor feedback. Student learning was assessed by means of task-specific metrics. The assessment occurred both formally through a series of Go/No Go criterion-based terrain board exams and AARs, and informally through classroom learning checks and performance on CCTT and DARWARS Ambush! exercises.

The quantitative data from the culminating terrain board exams failed to produce any substantive differentiation between the students in the experimental (GBT) and control (No-GBT) conditions. Of the students observed, all achieved 100% Go's on their first attempt. The

high success rate is not surprising given their relevant field experience prior to the course. In an attempt to collect more sensitive indicators, research-specific measures were recorded during terrain board exams. These measures included time to complete each task, number of times the instructor intervened (with helpful guidance), and post-exam ratings of student performance by instructors using a 10-point scale, with 1 representing the lowest performance and 10 the highest. No statistically significant differences were found for any of these measures (all $p$'s > .05). Numerous artifacts affected these data. For instance, there was a great deal of variability with respect to the instructor's willingness to guide students through the exam, the complexity of each task based on METT-TC conditions, and the instructor's application of the rating scale.

Students who observed the interaction between the instructor and the student-leader seemingly gained important insights during the PEs. Familiarity with the terrain board created a very comfortable setting for the students. They knew the terrain well and could quickly orient themselves and their vehicles on the it. However, the familiarity with the terrain may have discouraged thinking adaptively and generalizing across tactical conditions. At times, task visualization seemed to be hampered during terrain board instruction. For example, several students had difficulty with consolidation and reorganization. They seemed to have a hard time operating at the platoon level, visualizing four tank crews and the reports that would be sent from those crews.

Compared to the terrain board, the VBS2 game imposes real-time pacing, vehicle and weapon operating demands, movement and maneuver activities, crew interaction, command and control requirements, terrain complexities, and a battlefield environment rich in visual and audio cues (i.e., information to be processed). The venue compels the students to apply their tactical knowledge under complex (confusing) conditions rather than merely recite their text-book learning about high-level procedures in a relatively static environment. However, the students' ability to gain insights from the instructor-leader interactions was limited in the ALC program. Students not assigned to the leader role were actively engaged in playing non-leader roles in VBS2 exercises. Since the ALC program emphasizes leadership skills, students in non-leadership roles may not receive the maximum educational benefit from GBT as currently implemented[1]. In addition, communication limitations exist. All the students are in the same room and the lack of physical separation between crews discourages realistic communication. Student-to-student dialogue occurs directly (unaided) for tactical purposes.

During terrain board testing and CCTT exercises, no notable differences were observed in instructor interactions with the students across the treatment conditions. When provided, instructor comments during terrain board testing were general in nature (e.g., "What would you do next?"). Research team members noted that it would be feasible to conduct terrain board testing using VBS2 as a video terrain board. Testing could be performed by presenting students a "God's eye view" of the terrain using a large-screen display.

### *Feedback Data*

Instructors and students provided quantitative ratings and qualitative feedback (written and verbal) regarding the method of instruction used (terrain board or GBT). The surveys and

[1] One instructor was observed pausing VBS2 to facilitate interaction with all of the students at once and thereby overcome this limitation. However, this was not routine.

interviews occurred immediately after the practical exercise (APE) and at the end of the course (EOC). Participants used a 5-point scale (1-strongly disagree to 5-strongly agree), with higher values indicating more favorable or positive opinions. Inferential analysis was performed for the student rating data only, because sample sizes for the instructors were typically small. The major feedback findings are presented in descriptive fashion in this section.

Instructor data were limited, particularly the EOC data. Instructors' duties often limited their availability for data collection. As a result, only one instructor from the control condition (No-GBT) provided EOC ratings. The data from the instructors of both courses were combined for the primary analysis.

Across most of the quantitative feedback items, instructor ratings for enabling aspects of the method of PE execution were similar with a few notable exceptions (see Table 7). At the end of the research-focused PE, average ratings were higher for the GBT method than the terrain board method for the following items: (a) focusing student attention on the "how" and "why" of the execution, (b) providing a realistic command and control environment, and (c) allowing each student to optimally role-play his assigned position. By the end of the course, the same items continued to show a GBT advantage along with three new items—exposing students to operational risks, demonstrating how to overcome the risks, and allowing students to visualize the battlefield. However, any inferences are difficult to make given the small sample sizes (see Table 7) and large variability for the instructor rating data.

The student rating data obtained immediately after the research-focused PE are summarized in Table 8. Across the board the participants in both courses consistently indicated that GBT showed no notable advantage over the terrain board technique for executing PE missions. As the patterns in Table 8 indicate, no statistically significant differences emerged after correcting for multiple comparisons. The most striking feature of the data was their lack of differentiation among instructional methods or courses. Overall, the ratings for both methods of executing PE missions were positive.

Table 7
*Average Instructor Ratings of Practical Exercise Method at Two Points in Time*

| Enabling Aspect of PE Method | Time of Data Collection | | | |
|---|---|---|---|---|
| | APE | | EOC | |
| | No-GBT (n = 3) | GBT (n = 3) | No-GBT (n = 1) | GBT (n = 3) |
| Effectively address all teaching points | 4.50 (.71) | 4.25 (.50) | 4.00 (.00) | 4.00 (.00) |
| Provide environment for optimal learning | 4.50 (.71) | 4.50 (.58) | 4.00 (.00) | 4.50 (.71) |
| Provide useful arena for tactical execution | 4.50 (.71) | 4.50 (.58) | 4.00 (.00) | 4.50 (.71) |
| Expose students to operational risks | 4.00 (.00) | 4.25 (.50) | 3.00 (.00) | 4.50 (.71) |
| Demonstrate how to overcome operational risks | 4.00 (.00) | 4.25 (.50) | 3.00 (.00) | 4.50 (.71) |
| Engage students in mission-critical decisions | 4.50 (.71) | 4.50 (.58) | 4.00 (.00) | 4.50 (.71) |
| Focus attention on “how” and “why” of execution | 3.50 (.71) | 4.50 (.48) | 4.00 (.00) | 4.50 (.71) |
| Encourage student contributions and discussion | 4.50 (.71) | 4.25 (.50) | 4.00 (.00) | 4.50 (.71) |
| Allow students to visualize the battlefield | 4.00 (.00) | 4.67 (.58) | 2.00 (.00) | 4.50 (.71) |
| Provide realistic command & control environment | 3.00 (1.41) | 4.67 (.58) | 1.00 (.00) | 4.50 (.71) |
| Allow each student to role-play optimally | 3.00 (1.41) | 4.50 (.58) | 2.00 (.00) | 4.50 (.71) |
| Coach/instruct the students when needed | 4.50 (.71) | 4.50 (.58) | 4.00 (.00) | 4.50 (.71) |
| Allow students to work collaboratively | 4.50 (.71) | 4.25 (.50) | 5.00 (.00) | 4.50 (.71) |
| Efficiently teach students in time allotted | 3.50 (1.12) | 3.88 (.25) | 4.00 (.00) | 4.50 (.71) |
| Allow students to independently develop solutions | 4.00 (.00) | 4.25 (.50) | 4.00 (.00) | 4.50 (.71) |

*Note*. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

Table 8
*Average Student Ratings of Practical Exercise Method Immediately Post-PE*

| Enabling Aspect of PE Method | Course and PE Method | | | |
|---|---|---|---|---|
| | 19D | | 19K | |
| | No-GBT (n = 18) | GBT (n = 21) | No-GBT (n = 22) | GBT (n = 27) |
| Effectively understand all teaching points | 3.83 (.86) | 3.77 (.87) | 4.36 (.49) | 3.96 (.65) |
| Work in an environment for optimal learning | 3.82 (.81) | 3.91 (.92) | 4.41 (.73) | 3.78 (.89) |
| Work in a useful arena for tactical execution | 3.72 (.67) | 4.09 (.75) | 4.05 (.79) | 3.70 (.95) |
| Experience operational risks | 3.11 (1.02) | 3.81 (1.17) | 3.36 (1.09) | 3.85 (.95) |
| See how to overcome operational risks | 3.61 (.78) | 3.82 (.80) | 3.77 (.75) | 3.89 (.89) |
| Engage in making mission-critical decisions | 3.94 (.54) | 4.05 (.79) | 3.95 (.79) | 4.04 (1.02) |
| Concentrate on “how” & “why” of execution | 3.83 (.92) | 3.68 (.84) | 4.18 (.66) | 3.96 (.76) |
| Provide contributions and discussion | 4.22 (.55) | 3.91 (.87) | 4.32 (.72) | 4.04 (.71) |
| Visualize the battlefield | 3.67 (1.24) | 4.10 (.92) | 3.95 (.79) | 3.85 (1.2) |
| Experience realistic command and control | 3.33 (1.03) | 3.64 (1.14) | 3.45 (.96) | 3.85 (.99) |
| Optimally role-play assigned position | 3.39 (.98) | 4.18 (.73) | 3.86 (.89) | 3.93 (.92) |
| Receive coaching/instruction when needed | 4.22 (.73) | 4.14 (.77) | 4.45 (.51) | 4.15 (.66) |
| Work collaboratively with other students | 4.11 (.76) | 4.14 (.83) | 4.50 (.60) | 4.12 (.77) |
| Efficiently learn in time allotted | 3.67 (1.08) | 3.73 (1.08) | 4.27 (.70) | 3.68 (1.03) |
| Independently develop solutions | 3.83 (.71) | 3.73 (.70) | 4.00 (.69) | 3.89 (.70) |

*Note*. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

At the EOC, students once again provided ratings. However, this time they supplied ratings for both terrain board and GBT if they received both methods of instruction. In doing so they responded to the same questions using the established 5-point scale. In addition, they answered six items that asked them to directly compare the two methods of instruction. A 15-point preference scale was used, with "0-no preference" in the middle and the values 1-7 extending in both directions toward the respective anchors (terrain board and desktop gaming). These items can be viewed in Appendix G as part of the EOC survey questionnaire.

Table 9 summarizes the EOC student rating data. Across both courses and nearly all items, terrain board received higher ratings than GBT. Multiple *t*-tests were performed to compare ratings for the two methods of instruction. A Bonferroni correction accounted for family-wise comparisons. As seen in Table 9, several items showed statistically significant differences. Seemingly, the students held less favorable opinions of GBT as evidenced by the higher terrain board ratings.

Table 9
*Average Student Ratings of Practical Exercise Method at End of Course*

| Enabling Aspect of PE Method | Course and PE Method | | | |
|---|---|---|---|---|
| | 19D | | 19K | |
| | No-GBT (n = 19) | GBT (n = 18) | No-GBT (n = 21) | GBT (n = 27) |
| Effectively understand all teaching points | **3.89 (.85)** | **3.41 (.99)** | **4.06 (.86)** | **3.53 (.97)** |
| Work in an environment for optimal learning | **3.81 (.95)** | **3.23 (1.01)** | **4.02 (.91)** | **3.39 (1.02)** |
| Work in a useful arena for tactical execution | 3.81 (1.01) | 3.33 (1.01) | 3.79 (.99) | 3.44 (.97) |
| Experience operational risks | 3.50 (1.13) | 3.46 (.85) | 3.63 (1.12) | 3.53 (.94) |
| See how to overcome operational risks | 3.61 (1.02) | 3.44 (.88) | 3.69 (1.03) | 3.53 (1.03) |
| Engage in making mission-critical decisions | 3.77 (1.03) | 3.36 (.81) | 3.77 (1.04) | 3.58 (.97) |
| Concentrate on “how” & “why” of execution | 3.71 (1.14) | 3.28 (.94) | 3.96 (.94) | 3.49 (.98) |
| Provide contributions and discussion | **4.00 (.92)** | **3.33 (1.01)** | 3.98 (.98) | 3.5 (1.03) |
| Visualize the battlefield | **4.00 (.82)** | **3.23 (1.06)** | 3.81 (1.04) | 3.89 (.98) |
| Experience realistic command and control | 3.71 (1.1) | 3.46 (.82) | 3.52 (1.25) | 3.47 (1.18) |
| Optimally role-play assigned position | 3.71 (1.03) | 3.56 (.85) | 3.55 (1.16) | 3.69 (1.12) |
| Receive coaching/instruction when needed | 3.91 (.93) | 3.54 (.85) | **4.15 (.92)** | **3.47 (1.01)** |
| Work collaboratively with other students | 3.76 (.96) | 3.49 (.94) | 3.92 (1.05) | 3.67 (1.17) |
| Efficiently learn in time allotted | 3.62 (1.07) | 3.41 (.88) | **3.91 (.95)** | **3.14 (1.01)** |
| Independently develop solutions | 3.79 (.95) | 3.44 (.99) | 3.84 (.84) | 3.39 (.99) |

*Note*. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations. Figures in **bold** denote statistically significant differences between conditions.

The 15-point scales in the EOC feedback questionnaire asked students to directly compare terrain board versus desktop gaming by indicating which method of instruction was more effective. These scales framed “head-to-head” comparisons. The data from these scales were analyzed in two ways. First, the frequency with which a method of instruction received a rating in its direction served as a nominal measure with three categories—“response favors terrain board,” “no difference,” and “response favors GBT.” Second, the average numerical ratings in favor of terrain board and GBT were calculated to create an interval measure. The "no difference" ratings were excluded from this analysis.

The results from the *nominal* head-to-head data revealed more students found GBT to be more effective in several aspects of instruction according to a series of Chi square analyses (see Table 10). The relative advantages attributed to GBT included providing tactical realism, engaging students, stimulating realistic decision making, and prompting communication and teamwork skills.

Table 10
*Percent of Student Responses Favoring a Given Practical Exercise Method as More Effective*

| Enabling Aspect of PE Method | Terrain Board | No Difference | GBT | Chi Sq | *p* |
|---|---|---|---|---|---|
| Provides tactical realism | **25.00** | 19.74 | **55.26** | **16.76** | **<.001** |
| Causes students to be more engaged | **21.05** | 27.63 | **51.32** | **11.55** | **.003** |
| Produces better performance on CCTT | 22.37 | 36.84 | 40.79 | 4.29 | .17 |
| Allows knowledge sharing and vicarious learning | 25.33 | 36.00 | 38.67 | 2.24 | .33 |
| Stimulates realistic decision making | **16.22** | **24.32** | **59.46** | **23.46** | **<.001** |
| Prompts communication and teamwork skills | **13.33** | **29.33** | **57.33** | **22.32** | **<.001** |

*Note*. Figures in **bold** denote statistically significant differences between conditions. N = 85.

A different pattern of results emerged from the *interval* head-to-head data. A series of *t*-tests revealed no differences in student estimates of the degree to which each method of instruction was more effective (see Table 11). On balance, the interval and nominal data provide modest support for GBT. A greater number of students felt that GBT was more effective than terrain board on several aspects of instruction, while there were no aspects of instruction where a greater number of students indicated that terrain board was more effective than GBT. As shown in Table 10, the ratio of responses in favor of GBT training was generally two to four times the ratio for terrain board training. In fact, most of the responses (77%) which favored terrain board training over GBT training originated from a subset of 12 Soldiers.

Table 11
*Average Student Ratings of Effectiveness for Each Practical Exercise Method*

| Aspects of instruction | Terrain Board | Game-Based Training | t value | p |
|---|---|---|---|---|
| Provides tactical realism | 4.89 (1.52) | 4.23 (1.51) | 1.36 | .18 |
| Causes students to be more engaged | 5.19 (1.83) | 4.54 (1.82) | 1.26 | .21 |
| Produced better performance on CCTT | 4.88 (1.58) | 4.71 (1.64) | .35 | .73 |
| Allows students to share knowledge and learn from others mistakes | 4.68 (1.45) | 4.62 (1.70) | .13 | .89 |
| Stimulates realistic decision making | 5.00 (1.76) | 4.39 (1.92) | 1.00 | .32 |
| Prompts communication and teamwork skills | 4.80 (1.48) | 4.77 (1.77) | .05 | .96 |

*Note*. Figures in parentheses are standard deviations. N = 85.

Qualitative feedback (written and verbal) obtained from instructors and students is presented together in subsequent paragraphs. Several perceived benefits, limitations, and future applications were noted by the participants. These topics are addressed in turn.

Several positive aspects of the VBS2 training method were identified. Compared to DARWARS Ambush! graphics, which were described as a "distraction," VBS2 incorporated more "realistic" and "believable" graphics. Non-combatant entities such as civilians, insurgents and dogs maintained vigilance and flexibility at a high level. Compared to terrain board exercises, students reported many advantages of VBS2. For example, VBS2 offered the ability

to “train the group as a whole, instead of training students in pairs when using the terrain board.” The terrain board PEs were described as “limited,” “basic,” and low in their level of student engagement in comparison to VBS2 methods. While the terrain board was reported as being good for building “fundamental skills,” it lacked more “advanced applications.” In contrast, VBS2 was “engaging” and challenged students to put their knowledge to use more effectively. The VBS2 capabilities provided more tools for students to practice leadership, including “control of the whole platoon.” Consequently, students reported learning more about how to actually execute battle drills. The terrain board PEs were lacking because they gave students prior notification of enemy contact, allowing them to “prepare their answers ahead of time.” Using VBS2, students were expected to “react immediately,” making the system a good tool for “quick reaction thinking.” These qualities were reported to have the potential to give “better practice in practical communications, command and control, and overall mission accomplishment.”

Few negative comments and limitations were noted regarding the use of GBT methods. Both instructors and students expressed some discomfort with using VBS2 due to their lack of familiarity with the controls, indicating “more train-up would help.” Instructors also commented that GBT is sometimes unreliable relative to terrain boards; a “terrain board never freezes up, games crash.” Several students provided comments reflecting a general bias against GBT: “It’s a game – we aren't here to play games” and “I'm not going to take a game seriously. You even call it a game yourself.”

Other comments addressed the functionality and utility of VBS2. An example: "While playing in the first person mode, the ability to view the whole battlefield was limited with VBS2 as opposed to the terrain board." It was suggested that instead of using the first-person mode, some VBS2 PEs could be executed with a “God’s eye view.” This visualization perspective could be executed by “laying a monitor flat and using it as a digital terrain board.” Using this approach, students could “leverage the simulation’s abilities to serve as a terrain board.”

### *Lessons Learned*

The research in this project led to numerous lessons regarding various aspects of the GBT. The lessons stemmed from written and oral comments contributed by instructors and students as well as from input provided by researchers. As these lessons are discussed below, illustrative statements from participants will be included where appropriate.

Regarding future applications, the VBS2 game environment could be adapted to focus on particular students’ leadership strengths. It could be implemented using a “peer-coach method,” whereby students learn from others’ experience and wisdom. However, one could structure the responsibilities and AAR process so more students become “instrumentally engaged in the learning process.” This could involve designating them as mentors and having them share duties in a leader-team approach.

Performance shortcomings during this project’s GBT-supported PEs might have stemmed in part from “lack of true-to-life crew station controls,” “unfamiliarity with the VBS2 environment,” “lack of operator proficiency,” distraction, and a lack of communication. Due to these issues, student performance was reactive and exhibited a “lack of anticipation, which caused vehicles and dismounts to die several times.” Many of these issues could be addressed

via simple methods. Vehicle operating proficiency could be enhanced via the implementation of a joystick, "steering wheel," or an "M1 control orientation." Additionally, student VBS2 train-up could benefit from the expansion of facilities at duty stations to enable students to operate workstations more proficiently. During PEs, crews could be isolated (perhaps in cubicles) to "eliminate inter-vehicle distraction" and a voice-activated or push-to-talk hand microphone could be added to enhance communication. Finally, if VBS2 exercises included criterion-based grading, it could elevate their seriousness and enhance motivation among the students.

The instructor must "possess considerable proficiency as a workstation operator." The instructor must also fully understand the capabilities and limitations of the game software at a working level, even if he does not serve as the controller. Substantial time should be scheduled for instructor training, and an "optimized training support package (TSP) is needed to support efficient and effective game-specific training." For example, "The rules for conducting game-supported training exercises were not self-evident" to instructors. As such, the topic was easily ignored by trainers. Also, as technical problems occurred, the instructor had to "make decisions about moving crews, versus resetting or restarting the system in the absence of more formal guidelines." Thus, it may be advantageous for the "TSP to address basic troubleshooting and problem resolution procedures during instructor train-up."

To supplement formal PE lesson materials, the "TSPs should spell out the recommended rules regarding tactical communication, reconstitution of killed vehicles/dismounts, use of realistic battlefield views, and handling of technical problems." It is prudent to assume that technical problems will occur when using desktop games. A TSP should explain the types of problems that may occur and provide guidelines for dealing with contingencies that may arise.

## Conclusions and Recommendations

### *Conclusions*

The 19K experimental group performed better in the knowledge post-test than the control group. This result demonstrates selective evidence for the effectiveness of GBT. While there were no significant differences in ratings between the GBT and No-GBT conditions at the end of the research-focused PE, there were mixed responses at the end of the course. According to one set of measures, there was a general preference for terrain board instruction, while according to a different measure there was support for GBT. In addition, more students (typically a majority) indicated that GBT was more effective with certain aspects of the course. Both the experimental and control groups showed improvement in research-focused knowledge as measured through pre-test and post-test scores. This result demonstrates the ALC instruction effectively increased student knowledge.

Multiple experimental artifacts affected the data. Essentially there was no pure control group that received zero GBT experience in PEs. In attributing treatment effects, PEs could not be isolated from other sources of learning. Students were often tested in "mixed" groups, including students from both the experimental and control conditions. In addition, strong peer influence was observed in some groups reflecting a strong bias against GBT. These artifacts certainly temper the conclusions that can be drawn from the research. A future series of

experiments conducted in a well controlled setting would be required to generate definitive data free of extraneous and confounding variables.

Students and instructors provided valuable insights on how to best employ GBT in the ALC. Using VBS2 as a video terrain board could be considered the next evolutionary stage in infusing technological enhancements to improve training. Terrain boards have provided a low-tech solution to training, whereas VBS2 and other games can provide a richer and more realistic training environment. Dynamic, real-time events in GBT may help students to visualize the application of combat doctrine. Ultimately, these features are only beneficial when the broader goals of the course are taken into account. For courses such as the ALC programs, role playing can be limited to those in leadership positions, while the remaining students may learn better by observing than by role playing non-leadership roles.

*Recommendations*

The research team identified several areas in which harnessing GBT in the ALC program of instruction could be improved. The authors offer the following recommendations:

- Construct measures to effectively assess GBT effects: As corroborated by previous researchers (Hays, 2005), tests or measurement instruments do not exist for assessing many of the perceived benefits of GBT. Further research would be required to develop such measures.
- Tailor GBT to desired course outcomes: The application of GBT should be tailored to the specific needs and goals of a course. Curriculum designers should carefully consider and select the components of a game platform that enhance student learning. For example, using VBS2 as a virtual terrain board might enhance ALC learning when compared to a traditional terrain board. The VBS2 system allows the instructor to vary METT-TC conditions, induce surprise, provide dynamic events, and foster communication and control behaviors. Utilizing the technology in this manner could accelerate the development of decision-making and other leader attributes.
- Increase workstation proficiency: Soldiers' proficiency as workstation operators is critical. Substantial train-up is required (hours, not minutes), and the train-up must be supported by a carefully designed TSP that does not depend on gaming experts. Innovative techniques are required to produce minimum acceptable proficiency in a compressed timeframe that the typical program of instruction can afford.
- Improve understanding of games as training tools: Cadre members need to be educated on the unique capabilities and benefits of desktop games. Deliberate steps are required to overcome inertia and obtain buy-in on the part of the cadre. Beyond becoming a fully proficient workstation operator, the instructor must thoroughly understand the capabilities and limitations of the game software at a working level.
- Spell out rules for GBT exercises: The rules for conducting game-supported training exercises are not self-evident. The topic can be easily ignored by trainers. Soldier-friendly TSPs should spell out the recommended rules for tactical communication, reconstitution of killed vehicles/dismounts, use of realistic battlefield views, handling of technical problems, etc.

- Prepare instructors for basic troubleshooting and problem resolution: It is important to devise a game-based training process that does not depend on specialized technical support. Yet it is prudent to assume that technical problems will occur when using desktop games. Accordingly, it becomes imperative for the TSP to address basic troubleshooting and problem resolution procedures as part of the instructor train-up.
- Design well-controlled experiments around an applied skill: Sound experimental control is required to avoid deleterious effects of confounding variables. It may be beneficial to measure skill(s) requiring the *application* of knowledge as the outcome of training rather than knowledge per se. Applied measures may better assess GBT-based learning and produce more useful research results.

- Develop and resource a systematic GBT research program: Given the potential savings of GBT solutions, further research is warranted to determine the outcomes, effectiveness, application factors, and implementation enablers of GBT. This program could take advantage of the automatic data collection capabilities inherent in GBT to identify measures of performance and support a continuous evaluation of GBT.

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# APPENDIX A

## Acronyms and Abbreviations

| | |
|---|---|
| 19D | MOS identifier for Cavalry Scout |
| 19K | MOS identifier for Armor Crewman |
| AAR | after action review |
| ALC | Advanced Leaders Course |
| ANOVA | analysis of variance |
| APE | after practical exercise |
| ARFORGEN | Army Force Generation |
| ARI | U.S. Army Research Institute for the Behavioral and Social Sciences |
| CCTT | Close Combat Tactical Trainer |
| CNR-LOG | Communications Net Radio Logger |
| CNR-SIM | Communications Net Radio Simulator |
| COTS | commercial off-the-shelf |
| EOC | end of course |
| GBT | game-based training |
| METT-TC | mission, enemy, terrain and weather, troops and support available, time available, civil considerations |
| MMORPG | massively multiple online role-playing game |
| MOS | military occupational specialty |
| NCO | Noncommissioned Officer |
| NCOA | Noncommissioned Officers Academy |
| No-GBT | no game-based training [the “control” condition for the current research] |

| | |
|---|---|
| PE | practical exercise |
| PEO STRI | U. S. Army Program Executive Office for Simulation, Training, & Instrumentation |
| SME | subject matter expert |
| SPSS | Statistical Package for the Social Sciences |
| TRADOC | U. S. Army Training and Doctrine Command |
| TSP | training support package |
| USAARMC | U.S. Army Armor Center |
| VBS2 | Virtual Battlespace 2 |

APPENDIX B

# BIOGRAPHICAL SURVEY

PIN (last 4 of SSN): _____ Rank: _____ Branch/MOS: _____

Time in service: _____ yrs_____ mos Time in current grade (mos): _____

Course (circle one): 19D / 19K Role (circle one): Instructor / Student

**1. Military Training/Experience** (Check all that apply)

| Specialty Training | |
|---|---|
| Airborne | |
| Air Assault | |
| Ranger | |
| Special Operations | |
| Other _____ | |

| Jobs Performed | |
|---|---|
| Vehicle Commander | |
| Section or Team Leader | |
| Squad Leader | |
| Platoon Sergeant | |
| Company/Troop 1SG | |

**2. Assignment History** (List last three positions held, beginning with your most current one)

| Position | Time (months) |
|---|---|
| 1. | |
| 2. | |
| 3. | |

**3. Deployment Experience** (Provide information for all that apply)

| | Position(s) | Time (months) |
|---|---|---|
| **OIF** | | |
| **OEF** | | |
| **Bosnia** | | |
| **Other** | | |

**4. How much experience do you have conducting reconnaissance of a route/obstacle?**
(Circle one and explain)

3-Much Experience 2-Some Experience 1-Little Experience 0-None

*Please explain*:_____

_____

_____

**5. How much experience do you have conducting vehicle tactical movement?** (Circle one and explain)

3-Much Experience 2-Some Experience 1-Little Experience 0-None

*Please explain*:_____

_____

_____

**6. Civilian education** (circle one):

| 4-College Graduate | 3-Some College | 2-Technical School | 1-High School Graduate | 0-GED |
|---|---|---|---|---|

| **7. How much do you agree or disagree with the following statements regarding your skills and experiences:** | Circle One for Each Item | | | | |
|---|---|---|---|---|---|
| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| a. I am comfortable using a computer | 1 | 2 | 3 | 4 | 5 |
| b. I am proficient using a computer | 1 | 2 | 3 | 4 | 5 |
| c. I am experienced at playing video games | 1 | 2 | 3 | 4 | 5 |
| d. I regularly play combat-based video games such as "Call of Duty" | 1 | 2 | 3 | 4 | 5 |
| e. I have regularly conducted practical exercises using DARWARS | 1 | 2 | 3 | 4 | 5 |
| f. I have regularly conducted practical exercises using terrain board | 1 | 2 | 3 | 4 | 5 |
| g. I have regularly used terrain boards for training or operations | 1 | 2 | 3 | 4 | 5 |
| h. My deployment experience is relevant to this course | 1 | 2 | 3 | 4 | 5 |
| ***Comments and Suggestions:*** | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## Instructors Only

**8. How long have you been an instructor for this school?** _____ months

**9. Please indicate your previous experiences as an instructor or observer/controller.**

| Where | Position(s) | Time (months) |
|---|---|---|
| | | |
| | | |
| | | |

*End of Survey*

APPENDIX C

19K: Vehicle Tactical Movement
Pre-Test (with Answer Key)

**Student PIN _____** **Date: _____**

***Situation:*** *You are the platoon sergeant of 1st Platoon, B Company, 2-70 AR. You have four operational M1A1 Tanks. You are occupying AA Fox when you receive the following FRAGO:*

***FRAGO***

***Situation:*** *HUMINT has confirmed that elements of al Qaeda and local militant groups have been observed near the town of Masbete (OBJ BAT). It is believed they are planning attacks on civilians to disrupt religious celebrations in the town of Masbete, ignite ethnic tensions, and create instability in the town and surrounding ethnic enclave. We expect these elements to consist mainly of 3-5 man teams armed with RPGs located throughout the AO. 2-70 AR is currently conducting stability and security operations in AO THUNDER south of Masbete.*

***Mission:*** *1st platoon, B-Co, 2-70 AR attacks NLT XX0500AUG09C to destroy enemy forces on OBJ BAT to prevent enemy forces from attacking the civilian population and maintain stability in Masbete.*

***Execution:*** *1st platoon will SP from AA Fox at NLT 0445 and conduct a tactical roadmarch in column formation along route ZINC to LD/PL IRON. We will cross the LD in a wedge formation and attack through CPs 1, 3, 5, and 7 and clear enemy forces on OBJ BAT. If threat forces are encountered, the first priority is indirect fire. Only use direct fire if fired upon first. Current graphic control measures are in effect.*

***Service Support:*** *No change.*

***Command and Signal:*** *No change.*

1: What are the techniques of movement? **(Circle the best answer.)**

A. Traveling Overwatch, Fire and Movement, Follow and Support.
B. Alternate Bounds, Successive Bounds, Move and Set Technique.
C. Traveling, Traveling Overwatch, Bounding Overwatch.
D. Assault, Fire and Movement, Counterattack.

2: You know that during your movement you may be required to change your platoon's technique of movement. What factors would you consider when determining a technique of movement? **(Circle all that apply.)**

A. The likelihood of enemy contact.
B. Civilian considerations.
C. Planning range of the primary weapon system.
D. The availability of another element to provide overwatch.
E. The mission of the adjacent units.
F. The terrain over which the moving element will pass.

***Situation continued:*** *During your backbrief to the Commander, he provided the following additional guidance: "Once you cross PL IRON, contact is possible with combat outposts who will attempt to disrupt your movement. I need you to get to OBJ BAT quickly and clear any enemy forces there to prevent attacks on the local population."*

3: Based on this information which technique of movement would you choose? **(Circle the best answer.)**

A. Travelling
B. Travelling overwatch
C. Bounding overwatch
D. Fire and movement

***Situation continued****: During your platoon rehearsal, you decide to review the forms of contact and potential formations you will use during the operation.*

4. From the list below identify the possible forms of contact. **(Circle all that apply.)**

A. Audio
B. Visual
C. Indirect fire
D. Terrain
E. Buildings/Infrastructure
F. Civilians and nonhostile elements
G. Friendly unit
H. Aircraft

5: You decide to review selected formations with your platoon. Match the formations below to their descriptions. **(Place the number of the correct description in the blank beside each movement technique. Not all descriptions will be used.)**

_____ A. Vee
_____ B. Wedge
_____ C. Coil
_____ D. Staggered Column

(1) When it is operating independently, the platoon uses this formation to establish a perimeter defense during extended halts or lulls in combat.

(2) Formation with one section leading and one section trailing to provide overwatch. Permits good fire to the front and flanks. It is used when speed is critical, when there is a limited area for lateral dispersion, and/or when enemy contact is possible.

(3) Permits excellent firepower to the front and good firepower to the flanks. It is employed when the platoon is provided with overwatch by another element and is moving in open or rolling terrain.

(4) Provides excellent control and fire to the flanks, but permits less fire to the front. It is used when speed is critical, when the platoon is moving through restricted terrain on a specific route, and/or when enemy contact is not likely.

(5) Provides excellent protection and control, but limits fires to the front. This formation is used when terrain restricts movement or when overwatch within the platoon is required.

6. During your rehearsal, you also decide to review four of the seven battle drills with your platoon. **(Place the number of the correct description in the blank beside each battle drill. Not all descriptions will be used.)**

_____ A. Change of formation drill.
_____ B. Contact drill.
_____ C. Action drill
_____ D. React to indirect fire drill

(1) This drill permits the entire platoon to change direction rapidly in response to terrain conditions, obstacles, FRAGOs from the commander, or enemy contact.

(2) When executing this drill, counterattack force uses tactical maneuver to gain a position of advantage from which it attacks the enemy (from the flank, whenever possible). It conducts hasty attacks and assaults based on the particular situation and the METT-TC factors.

(3) This drill is executed to accomplish a rapid change in formation in response to a change in terrain or enemy situation.

(4) When executing this drill, the platoon moves out of the area, unless it is also engaged in direct fire contact or is directed to remain stationary.

(5) This drill enables the platoon to orient weapon systems and engage an enemy without changing its direction or speed of movement along the axis of advance. It is used when contact is made with small arms fire, non-armor-defeating weapons, or when the platoon sights the enemy without being engaged and does not want to stop or slow its movement.

***Situation continued:*** *As you cross the LD with your platoon, you begin to receive RPG fire from the north. You observe three men running from the location where the rocket was fired. Your wingman reports "Contact, RPG, North" and begins to engage with small arms.*

7. There are four steps that allow the platoon leader to execute actions on contact using a logical, well-organized decision-making process. What are they? **(Circle all that apply.)**

A. Execute the COA
B. Attack to destroy
C. Choose and recommend a COA and maneuver the force
D. Conduct fire and movement
E. Gain and maintain contact
F. Deploy and report
G. Evaluate and develop the situation

8. The four-step process of Actions on Contact is not a rigid, lockstep response to enemy contact but a process with defined goals. What are those goals? **(Circle all that apply.)**

A. Provide an orderly framework.
B. Enable the platoon to survive the initial contact.
C. Gather reports of enemy contact.
D. Apply sound decision-making and timely actions to complete the operation.
E. Send accurate, timely reports to the commander.
F. Enable the platoon to react instinctively and instantly to the contact.
G. Determine if the commander's intent has been met.
H. Allow the platoon leader to quickly decide on a COA.
I. Maintain the overall tempo of the attack.

9. You have deployed your platoon in response to the RPG attack by initiating the Contact Battle Drill. As you begin to analyze and develop the situation, you know that your primary focus should be on what? **(Circle the best answer.)**

A. Identify which vehicles will engage the enemy, what type of ammunition to use, and how many rounds each vehicle will fire.
B. Determine/confirm the size, composition, activity, and orientation of the enemy force.
C. Move all vehicles to covered and concealed positions, use one section to fix the enemy, and use the other section to maneuver against and destroy the enemy.
D. Bypass the enemy, handoff the RPG Team to another platoon in the company, and continue the attack to OBJ BAT to meet the Commander's guidance and intent.

10. Now that you have developed the situation and determined that you have enough information to make a decision, you select a COA that: **(Circle the best answer.)**

A. Destroys the enemy and creates the fewest casualties in the platoon.
B. Supports the commander's intent and is within the platoon's capabilities.
C. Allows the platoon to quickly continue its mission and keep the commander informed.
D. Maintains the attack tempo and offers the best chance of accomplishing the mission.

11. Your assessment is that the RPG team is an inferior force and can quickly be destroyed by the platoon. What COA will you recommend to Black-6? **(Circle the best answer.)**

A. COA1: Initiate a Contact Drill, issue a section fire command, continue to move along your assigned axis or route engaging until the enemy is destroyed.
B. COA 2: Initiate an Action Drill with enemy contact, bring your platoon on line, issue a platoon fire command, and assault the enemy position.
C: COA 3: Initiate an Action Drill, use one section to establish a support by fire position and use fire and movement to maneuver the other section to a position of advantage, destroy the enemy and continue the mission.
D. COA 4: Report the contact to the company commander and recommend that another platoon be tasked to destroy the enemy force.

***Situation continued:*** *You have destroyed the RPG team and are continuing the mission. As you near CP5 you are engaged by multiple RPG teams from the north. You determine this is a superior force.*

12. What COA will you choose? **(Circle the best answer.)**

A. COA 1: Initiate a Contact Drill, issue a section fire command, continue to move along your assigned axis or route engaging until the enemy is destroyed.
B. COA 2: Initiate an Action Drill with enemy contact, bring your platoon on line, issue a platoon fire command, and assault the enemy position.
C. COA 3: Initiate an Action Drill, use one section to establish a support by fire position and use fire and movement to maneuver the other section to a position of advantage, destroy the enemy and continue the mission.
D. COA 4: Order your platoon to seek covered and concealed positions, report contact to the commander, use direct and indirect fire to fix the enemy, recommend to the commander that 1st platoon continue to fix the enemy while 2nd or 3rd maneuvers to destroy the enemy.

## ANSWER KEY

| Question | Answer | Doctrinal Reference/Rationale |
|---|---|---|
| 1 | C | FM 3-20.15, Chapter 3, page 3-10, paragraph 3-54 states "The tank platoon must be able to employ any of the following techniques of movement: Traveling, Traveling Overwatch, or Bounding Overwatch." |
| 2 | A<br>D<br>F | FM 3-20.15, Chapter 3, page 3-9, paragraph 3-52 states "The commander or platoon leader selects a technique of movement based on several battlefield factors:<br>• The likelihood of enemy contact.<br>• The availability of another element to provide overwatch for the moving element.<br>• The terrain over which the moving element will pass. |
| 3 | B | FM 3-20.15, Chapter 3, page 3-10, paragraph 3-54 states "Traveling overwatch is an extended form of traveling that provides additional security when contact is possible but speed is desirable." |
| 4 | B<br>C<br>F<br>H | FM 3-20.15, Chapter 3, page 3-19, paragraph 3-80 states "The platoon leader deploys the platoon when he recognizes one of the general categories of initial contact or receives a report of enemy contact. No matter how thoroughly the platoon leader prepares for an operation, direct contact with the enemy is still a possibility, usually as a result of chance contact. In all types of operations, contact occurs when an individual Soldier, squad, or section of the platoon encounters any situation that requires an active or passive response to the threat. These situations may entail one or more of the following ***eight forms of contact***:<br>• Visual contact (friendly elements may or may not be observed by the enemy).<br>• Physical contact (direct fire) with an enemy force.<br>• Indirect fire contact.<br>• Contact with obstacles of enemy or unknown origin.<br>• Contact with enemy or unknown aircraft.<br>• Situations involving CBRN conditions.<br>• Situations involving electronic warfare tactics (such as jamming, interference, and imitative deception).<br>• Situations involving nonhostile elements (such as civilians)." |

| Question | Answer | Doctrinal Reference/Rationale |
|---|---|---|
| 5 | A-5<br>B-3<br>C-1<br>D-2 | FM 3-20.15, Chapter 3, pages 3-11 through 3-16 describe the six basic movement formations and the two stationary formations the platoon will use.<br><br>The **column** formation provides excellent control and fire to the flanks, but permits less fire to the front. It is used when speed is critical, when the platoon is moving through restricted terrain on a specific route, and/or when enemy contact is not likely.<br><br>The **staggered column** formation is a modified column formation with one section leading and one section trailing to provide overwatch. The staggered column permits good fire to the front and flanks. It is used when speed is critical, when there is a limited area for lateral dispersion, and/or when enemy contact is possible.<br><br>The **wedge** formation permits excellent firepower to the front and good firepower to the flanks. It is employed when the platoon is provided with overwatch by another element and is moving in open or rolling terrain. Depending on the platoon location within the company formation, the platoon leader and PSG (with wingmen) can switch sides of the formation. When the platoon leader's tank is slightly forward, one flank has more firepower.<br><br>The **echelon** formation permits excellent firepower to the front and to one flank. It is used to screen an exposed flank of the platoon or of a larger moving force.<br><br>The **vee** formation provides excellent protection and control, but limits fires to the front. This formation is used when terrain restricts movement or when overwatch within the platoon is required.<br><br>The **line** formation provides maximum firepower forward. It is used when the platoon crosses danger areas and is provided with overwatch by another element or when the platoon assaults enemy positions.<br><br>When it is operating independently, the platoon uses the **coil formation** to establish a perimeter defense during extended halts or lulls in combat. The lead vehicle will halt his vehicle in the direction of travel (12 o'clock) while the other vehicles position themselves to form a circular formation covering all suspected enemy avenues of approach.<br><br>The **herringbone** formation is used when the platoon must assume a hasty defense with 360-degree security while remaining postured to resume movement in the direction of travel. It is normally employed during scheduled or unscheduled halts in a road march. If terrain permits, vehicles should move off the route and stop at a 45-degree angle, allowing passage of vehicles through the center of the formation. |

| Question | Answer | Doctrinal Reference/Rationale |
|---|---|---|
| 6 | A-3<br>B-5<br>C-1<br>D-4 | FM 3-20.15, Chapter 3, paragraphs 3-103 – 3-120, pages 3-25 through 3-36 describe the seven battle drills and the steps taken to accomplish each drill. Excerpts appear below:<br><br>**Change of Formation Drill:** This drill is executed to accomplish a rapid change of formation in response to a change in terrain or enemy situation. The platoon leader must ensure that each TC knows the new formation and the relative position of each tank in the new formation. He uses visual signals and/or the radio to initiate the drill.<br><br>**Contact Drill:** The contact drill enables the platoon to orient weapon systems and engage an enemy without changing its direction or speed of movement along the axis of advance. This drill is used when contact is made with small arms fire, non-armor-defeating weapons, or when the platoon sights the enemy without being engaged and does not want to stop or slow its movement. The platoon leader initiates the contact drill using visual signals and/or the radio.<br><br>**Action Drill:** The action drill permits the entire platoon to change direction rapidly in response to terrain conditions, obstacles, FRAGOs from the commander, or enemy contact.<br><br>**React to Indirect Fire Drill:** When the platoon receives unexpected indirect fire, it moves out of the impact area, unless it is also engaged in direct fire contact or is directed to remain stationary. TCs place their hatches in the open protected position; other crewmen close their hatches.<br><br>**React to Air Attack Drill:** When the platoon observes high-performance aircraft, helicopters, or unmanned aircraft system (UAS) that could influence its mission, it initially takes passive air defense measures unless the situation requires immediate active measures. In a passive air defense, the platoon disperses or stops, to avoid detection altogether and/or to minimize the aircraft's target acquisition capability. The platoon also prepares for active air defense measures.<br><br>**React to a Nuclear Attack Drill:** When the platoon observes a brilliant flash of light and mushroom-shaped cloud, crew members must act quickly to minimize the effects of a nuclear detonation.<br><br>**React to a Chemical/Biological Attack Drill:** The platoon initiates this drill during an operation whenever an automatic masking event occurs, the chemical agent alarm sounds, M8 detection paper indicates the presence of chemical agents, or a Soldier suspects the presence of chemical or biological agents. |

| Question | Answer | Doctrinal Reference/Rationale |
|---|---|---|
| 7 | A<br>C<br>F<br>G | FM 3-20.15, Chapter 3, page 3-18, paragraph 3-77 states "The following four steps allow the platoon leader to execute actions on contact using a logical, well-organized decision-making process:<br>• Deploy and report.<br>• Evaluate and develop the situation.<br>• Choose a COA.<br>• Execute the selected COA." |
| 8 | A<br>B<br>D<br>F<br>G | FM 3-20.15, Chapter 3, page 3-19, paragraph 3-78 states "The four-step process is not a rigid, lockstep response to the enemy contact. Rather, the goal is to provide an orderly framework that enables the platoon to survive the initial contact, and then apply sound decision-making and timely actions to complete the operation. In simplest terms, the platoon must react instinctively and instantly to the contact, and the platoon leader must decide, with equal dispatch, whether to execute a preplanned battle drill or COA or to recommend and execute an alternate drill or action." |
| 9 | B | FM 3-20.15, Chapter 3, page 3-19, paragraph 3-84 states "His primary focus is on determining and/or confirming the size (inferior or superior), composition (available weapon systems), activity, and orientation of the enemy force." |
| 10 | B | FM 3-20.15, Chapter 3, page 3-20, paragraph 3-88 states "Once the platoon leader develops the situation and determines that he has enough information to make a decision, he selects a COA that both meets the requirements of the commander's intent and is within the platoon's capabilities. He has several options in determining the COA:<br>• Direct the platoon to execute the original plan. The platoon leader selects the COA specified by the company commander in the OPORD.<br>• Based on the situation, issue FRAGOs to refine the plan, ensuring it supports the commander's intent.<br>• Report the situation and recommend an alternative COA based on known information in response to an unforeseen enemy or battlefield situation.<br>• Direct the platoon to execute tactical movement (employing bounding overwatch and support by fire within the platoon) and reconnaissance by fire to further develop the situation and gain the information the platoon leader needs to clarify a vague battlefield picture. |
| 11 | C | FM 3-20.15 Chapter 3, page 3-21, paragraph 3-101 describes actions on contact with an inferior force. |
| 12 | D | FM 3-20.15 Chapter 3, page 3-22, paragraph 3-102 describes actions on contact with a superior force. |

**Source:** FM 3-20.15, Tank Platoon, US Army, Feb 07

APPENDIX D

Observer's Guide – Practical Exercises

ADMINISTRATIVE DATA

A. Observer's Name: _____

B. Date of Observation: ____

C. Course: ____

C-2. Condition: Experimental / Control

D. Name of PE: _____

E. # Students and Their Roles: _____
_____
_____

F. # Instructors and Their Roles: _____
_____
_____

G. # Workstations Used (VBS2): _____

H. Observation Start Time: _____

I. Observation End Time: _____

J. Total # Exercise Iterations Run: _____

K. Support Personnel: _____
_____

QUESTIONS OF INTEREST

| **Learning Environment** |
|---|
| 1. How does the instructor establish a tactical context (e.g., briefing, anecdote, video)? |
| 2. How many students actively participate at a time? What roles are played by students? |
| 3. How do tactical communications occur (e.g., face-to-face, voice-over-internet protocol)? |
| 4. What problems are encountered? Consider (a) representing friendly/enemy elements, (b) representing terrain and obstacles, (c) communicating, (d) moving tactically & maneuvering, (e) representing OPFOR actions, (f) representing battlefield effects, and (g) other? |
| 5. How comfortable does the instructor appear to be using the VBS2 workstation? |
| 6. How comfortable do the students appear to be using the VBS2 workstations? |
| **Preparation Activities** |
| 7. What materials does the instructor use to create the tactical context? |
| 8. How does the instructor issue the OPORD and explain the mission? |
| 9. How does the instructor vary the mission planning and preparation activities to fit the different execution modes (terrain board, DARWARS, VBS2)? |
| 10. Is a mission rehearsal conducted? How? Who participates? |
| 11. What VBS2 train-up is conducted? How long does it last? |
| 12. How does the instructor verify readiness to execute the mission? |
| **Execution Activities** |
| 13. What exercise control functions does the instructor perform? How? |
| 14. How do the students interact with the instructor(s)? Describe what you see. |
| 15. How do the students interact with each other? Describe what you see. |
| 16. How well is mission execution performed? What aspects are unique to the mode? |
| 17. How well can the instructor monitor student performance? |
| 18. How many times does the instructor coach or prompt a student to achieve the correct outcome? Record the most accurate count feasible, for each iteration. |
| 19. How well can the instructor enforce the published rules of the exercise? |
| 20. How long does mission execution last? Record start and stop times, by iteration. |
| **Assessment and Feedback** |
| 21. How does the instructor observe and record measures of performance? |
| 22. Does the instructor provide feedback during mission execution? If so, how? |
| 23. How does the instructor conduct AARs? How long does each AAR last? |
| 24. How well do the students participate or contribute in the AARs? |
| 25. Does the AAR facilitator use the VBS2 system to support AARs? If yes, how? |

| **Participation Management** |
| --- |
| 26. How many iterations are completed in the course of the PE? |
| 27. How does the instructor decide when a given iteration is complete? |
| 28. How many students serve in leadership positions across all iterations? |
| 29. Does the instructor restrict leaders of later iterations from observing earlier iterations? How? |
| 30. What do students not assigned a leadership role do during terrain board execution of a mission? |
| 31. How does the instructor introduce new challenges for leaders performing in later iterations? |
| 32. Do VBS2 workstations expand student participation? Describe what you see. |
| **Other Questions** |
| 33. How well do the VBS2 capabilities support the training objectives of the PE? |
| 34. What VBS2 capabilities does the instructor utilize? What capabilities are not utilized? |
| 35. What technical or operational problems occur? How are the problems handled? |
| 36. Do the PE materials appear to contribute to any problems observed during the PE? If yes, how? |
| 37. How do the more experienced students share their knowledge and lessons learned with other students? |
| 38. How would you improve the PE procedures to enhance student learning? |
| 39. What insights do you have for implementing game-based training methods? |

APPENDIX E

Student Feedback Questionnaire – After Practical Exercise (APE)

Date: _____ PIN Number: _____ Course (circle one): 19D 19K

PE Method Used (circle one): Terrain Board VBS2 DARWARS

Instructions: The questions below ask for your opinions about the instructional methods used during the practical exercise you just completed. While answering these questions, focus on the impact the method of instruction (terrain board or desktop gaming) had on training. Write-in comments, both positive and negative, are encouraged. Please use a separate sheet of paper if you need additional space.

| **1. By using the designated method (terrain board or desktop gaming) during the practical exercises, how much do you agree or disagree that you as the Student were able to:** | Circle One for Each Item | | | | |
|---|---|---|---|---|---|
| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| a. Thoroughly understand all teaching points | 1 | 2 | 3 | 4 | 5 |
| b. Work in an environment for optimal learning | 1 | 2 | 3 | 4 | 5 |
| c. Work in a useful arena for tactical execution | 1 | 2 | 3 | 4 | 5 |
| d. Experience operational risks | 1 | 2 | 3 | 4 | 5 |
| e. Demonstrate how to overcome operational risks | 1 | 2 | 3 | 4 | 5 |
| f. Effectively engage in making mission-critical decisions | 1 | 2 | 3 | 4 | 5 |
| g. Focus your attention to the "how" and "why" of the execution | 1 | 2 | 3 | 4 | 5 |
| h. Provide contributions and discussion | 1 | 2 | 3 | 4 | 5 |
| i. Visualize the battlefield | 1 | 2 | 3 | 4 | 5 |
| j. Work in a realistic command and control environment | 1 | 2 | 3 | 4 | 5 |
| k. Optimally role-play your assigned position | 1 | 2 | 3 | 4 | 5 |
| l. Receive coaching/instruction when needed | 1 | 2 | 3 | 4 | 5 |
| m. Work collaboratively with other students | 1 | 2 | 3 | 4 | 5 |
| n. Efficiently learn in the time allotted | 1 | 2 | 3 | 4 | 5 |
| o. Independently develop solutions | 1 | 2 | 3 | 4 | 5 |
| ***Comments and Suggestions:*** | | | | | |
| | | | | | |
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| **2. What problems did you encounter during the terrain board or desktop gaming phases?** |
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| 3. What are the limitations with the method used to conduct the practical exercise? |
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| 4. What would you change to improve practical exercise learning? |
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**Note: The remaining questions are only for students who used VBS2 during the PE.**

| 5. What are your general impressions of VBS2 desktop game training? |
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| 6. What are the biggest advantages of VBS2 training over terrain board training or DARWARS? |
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| 7. What are the disadvantages of VBS2 training compared to terrain board training or DARWARS? |
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| 8. What would you change about VBS2 training to improve its effectiveness? |
|---|
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| |

**Thank you for your feedback!**

APPENDIX F

19K: Vehicle Tactical Movement
Post-Test (with Answer Key)

**Student PIN _____** **Date: _____**

***Situation:*** *You are the acting platoon leader of 2nd Platoon, B Company, 2-70 AR. You have four operational M1A1 Tanks. The battalion has deployed as part of a multinational force in support of JTF Madera that has been conducting offensive operations to eject Coronian forces from Madera and restore the International Border. Your platoon is currently in AA GOLD preparing for combat operations, when you receive the following WARNO*

***WARNO***

***Situation:*** *Elements of the Independent Mission Detachment (IMD) of the 160th Brigade Tactical Group (BTG) have been observed setting up a hasty defense on OBJ IRON to establish the BTG disruption zone. The IMD is a mechanized infantry company reinforced with a tank platoon, an AT-4 antitank platoon (AT), an AT-5 AT Section from the Brigade Tactical Group, reconnaissance platoon (BRDM), mortar, and ADA platoons. 4-99 CAV (Maderian) is currently conducting screening operations along PL UTAH.*

***Mission:*** *2nd platoon, B-Co, 2-70 AR attacks NLT XX0500AUG09C to destroy enemy forces in zone and seize OBJ IRON EAST to set the conditions for forward passage of lines of 1-41 IN (M) (BCT Main Effort).*

***Execution:*** *2nd platoon will SP from AA GOLD NLT 0445 and conduct a tactical roadmarch in column formation along route ZINC to LD/PL UTAH. We will cross the LD in a wedge formation and attack through CPs 2, 4, 6, and 8 and seize OBJ IRON EAST. If we encounter threat forces, the first priority is indirect fire. Use direct fire only if fired upon first. Current graphic control measures are in effect.*

***Service Support:*** *No change.*

***Command and Signal:*** *No change.*

1. The execution of troop leading procedures (TLP) involves analyzing the terrain. What acronym best describes the factors used to analyze the terrain? **(Circle the correct answer.)**

A. PMCS-A
B. ASCOPE
C. METT-TC
D. MDMP
E. OAKOC

2: In the WARNO you were told that your platoon would cross the LD in a wedge formation. What can you assume from this information about the availability of overwatch and the condition of the terrain? **(Circle the best answer.)**

A. The platoon must provide its own overwatch and the terrain is restrictive.
B. The platoon must provide its own overwatch and the terrain is open and rolling.
C. Overwatch will be provided by another platoon and the terrain is open and rolling.
D. Overwatch will be provided by another platoon and the terrain is restrictive.

***Situation continued:*** *During your backbrief to the Commander, he provided the following additional guidance: "Once you approach CP 2, contact is likely with an AT section of the IMD's AT-4 antitank platoon who will attempt to disrupt your maneuver. 1st and 3d Platoons will not be able to provide overwatch. I need you to destroy the AT section to maintain the momentum of the company's attack."*

3: Based on the Commander's guidance, which movement technique would you choose? **(Circle the best answer.)**

A. Travelling
B. Travelling overwatch
C. Bounding overwatch
D. Fire and movement

4. Since you will not be provided with overwatch from the other platoons in the company, what platoon formation would you choose? **(Circle the best answer.)**

A. Wedge
B. Vee
C. Echelon
D. Line

***Situation continued****: During your platoon rehearsal, you decide to review the forms of contact and potential formations you may use during the operation.*

5. From the list below, identify the items that are possible forms of contact. **(Circle all that apply.)**

A. Audio
B. Buildings
C. CBRN
D. Obstacles
E. Electronic warfare
F. Coalition units
G. Physical
H. Terrain
I. Visual

6. You decide to review selected formations with your platoon. Match the formations below to their descriptions. **(Place the number of the correct description in the blank beside each formation. Not all descriptions will be used.)**

_____ A. Echelon
_____ B. Herringbone
_____ C. Line
_____ D. Column
_____ E. Wedge
_____ F. Vee

(1) This formation is used when the platoon must assume a hasty defense with 360-degree security while remaining postured to resume movement in the direction of travel. It is normally employed during scheduled or unscheduled halts in a road march.

(2) Provides excellent control and fire to the flanks, but permits less fire to the front. It is used when speed is critical, when the platoon is moving through restricted terrain on a specific route, and/or when enemy contact is not likely.

(3) Permits excellent firepower to the front and to one flank. It is used to screen an exposed flank of the platoon or of a larger moving force.

(4) Provides maximum firepower forward. It is used when the platoon crosses danger areas and receives overwatch from another element, or when assaulting enemy positions.

(5) Provides excellent protection and control, but limits fires to the front. This formation is used when terrain restricts movement or when overwatch within the platoon is required.

(6) Permits excellent firepower to the front and good firepower to the flanks. It is employed when the platoon is provided with overwatch by another element and is moving in open or rolling terrain.

(7) This formation permits good fire to the front and flanks and uses one section leading and one trailing to provide overwatch.

7. During your rehearsal, you also decide to review some of the seven battle drills with your platoon. **(Place the number of the correct description in the blank beside each battle drill. Not all descriptions will be used.)**

_____ A. React to air attack drill
_____ B. Contact drill
_____ C. React to a nuclear attack drill
_____ D. React to a chemical/biological attack drill
_____ E. React to indirect fire drill
_____ F. Action drill

(1) This drill enables the platoon to orient weapon systems and engage an enemy without changing its direction or speed of movement along the axis of advance. It is used when contact is made with small arms fire, non-armor-defeating weapons, or when the platoon sights the enemy without being engaged and does not want to stop or slow its movement.

(2) When the platoon observes this type of enemy force that could influence its mission, it initially takes passive defense measures unless the situation requires immediate active measures.

(3) When the platoon observes a brilliant flash of light and a mushroom-shaped cloud, crewmembers must act quickly to minimize the effects of this type of attack.

(4) When executing this drill, the platoon bypasses the enemy to maintain the tempo of the attack. This drill may be executed against a superior or inferior force. Once clear of the enemy, the platoon hands the enemy over to another force, breaks contact, and rejoins the company.

(5) The platoon initiates this drill during an operation whenever an automatic masking event occurs.

(6) This drill permits the platoon to change direction rapidly in response to terrain conditions and enemy contact.

(7) When executing this drill, the platoon displaces unless it is also engaged in direct fire contact or is directed to remain stationary.

***Situation continued:*** *As you approach CP 2, you begin to receive AT fire from the north. You observe two BRDMs displacing from the location where the AT-4s were fired. Your wingman reports "Contact, Antitank, North" and begins to engage with tank main gun.*

8. You send a contact report to the Commander and execute a contact drill. As part of Actions on Contact, you must determine if the enemy is a superior or inferior force. How do you define an inferior force? **(Circle the correct answer.)**

A. An inferior force is an enemy element that the platoon outnumbers 3 to 1.
B. An inferior force is composed of 50% fewer vehicles than the platoon.
C. An inferior force is an enemy element that the platoon can destroy while remaining postured to conduct further operations.
D. An inferior force can be destroyed only through a combined effort of the company.

9. When initiating Actions on Contact, what two things must the platoon leader understand from the OPORD? **(Circle all that apply.)**

A. The Commander's intent
B. Coordinating instructions
C. The scheme of maneuver
D. Succession of command
E. The enemy SITTEMP

10. You have initiated a contact drill in response to the AT-4 attack. Now you determine or confirm the size, composition, activity, and orientation of the enemy force. To which step of Actions on Contact does this apply? **(Circle the best answer.)**

A. Deploy and report.
B. Execute the course of action.
C. Choose a course of action.
D. Evaluate and develop the situation.
E. Recommend a course of action.

11. As part of your battle drill, you order your Alpha Section to provide stationary overwatch while Bravo Section maneuvers to a position of advantage. Stationary overwatch is best described as what? **(Circle the best answer.)**

A. A tactical mission in which a friendly moving element uses fire and movement to maneuver to a position of advantage and destroy a stationary enemy element.
B. A tactical mission in which an element maintains continuous communications with a friendly moving element and alerts them of imminent contact.
C. A tactical mission where an element's task is to destroy the enemy using long-range fires from dominating terrain or by using standoff of the main gun.
D. A tactical mission in which an element observes and provides direct fire support for a friendly moving element.

***Situation continued:*** *You have destroyed the AT-4 section and are continuing the mission. As you near CP 6, your Bravo Section is engaged by direct fire from the North. You cannot determine if this is a superior or inferior force.*

12. You send the Commander a contact report and order the platoon to execute a platoon action drill. What are your actions? **(Circle the best answer.)**

A. Suppress the threat position with indirect fires and execute an assault battle drill to destroy the enemy.

B. Order Bravo Section to establish a support by fire position and suppress the threat, maneuver your Alpha Section to gain positional advantage over the threat.

C. Seek covered and concealed positions, dismount an armored crewman to move to an OP position to call for indirect fire, and determine the size and composition of the threat force.

D. Establish a platoon support by fire position, call for indirect fires, and recommend to the Commander that 1st and 3d platoons maneuver to destroy the enemy.

13. As you continue to develop the situation, you observe four dug in BMP-2s and a T-80U tank. What are your actions? **(Circle the best answer.)**

A. Seek covered and concealed positions, send the Commander a SPOTREP recommending your platoon establish an attack by fire position to fix the enemy and the remainder of the company bypass the enemy and continue the attack to seize OBJ IRON EAST.

B. Seek covered and concealed positions, send the Commander a SPOTREP, suppress the enemy force with indirect fires and smoke to obscure your maneuver, and then continue the attack using alternate bounds to destroy the threat.

C. Seek covered and concealed positions, send the Commander a SPOTREP, initiate an Assault Drill, use one section to establish a support by fire position, use fire and movement to maneuver the other section to a position of advantage, destroy the enemy and continue the mission.

D. Seek covered and concealed positions, send the Commander a SPOTREP recommending your platoon establish a support by fire position to fix the enemy and 1st and 3d platoons maneuver to destroy the enemy.

## ANSWER KEY

| Question | Answer | Doctrinal Reference/Rationale |
|---|---|---|
| 1 | E | FM 3-20.15, Chapter 3, page 3-4, paragraph 3-22 states, "The platoon leader conducts a map reconnaissance and uses the factors of OAKOC, as discussed in Chapter 2, to systematically analyze the terrain in his AO." |
| 2 | C | FM 3-20.15, Chapter 3, page 3-13, paragraph 3-60 states, "The wedge formation permits excellent firepower to the front and good firepower to the flanks (see Figure 3-6). It is employed when the platoon is provided with overwatch by another element and is moving in open or rolling terrain." |
| 3 | C | FM 3-20.15, Chapter 3, page 3-10, paragraph 3-54 states: Bounding overwatch is used when contact is expected. It is the most secure, but slowest, movement technique. Bounding may be no greater than one-half the weapon's planning range. This allows the overwatch section to have effective fires forward of the bounding section." |
| 4 | B | FM 3-20.15, Chapter 3, page 3-14, paragraph 3-62 states, "The vee formation provides excellent protection and control, but limits fires to the front. This formation is used when terrain restricts movement or when overwatch within the platoon is required." |
| 5 | C<br>D<br>E<br>G<br>I | FM 3-20.15, Chapter 3, page 3-19, paragraph 3-80 states, "The platoon leader deploys the platoon when he recognizes one of the general categories of initial contact or receives a report of enemy contact. No matter how thoroughly the platoon leader prepares for an operation, direct contact with the enemy is still a possibility, usually as a result of chance contact. In all types of operations, contact occurs when an individual Soldier, squad, or section of the platoon encounters any situation that requires an active or passive response to the threat. These situations may entail one or more of the following ***eight forms of contact***:<br>• Visual contact (friendly elements may or may not be observed by the enemy).<br>• Physical contact (direct fire) with an enemy force.<br>• Indirect fire contact.<br>• Contact with obstacles of enemy or unknown origin.<br>• Contact with enemy or unknown aircraft.<br>• Situations involving CBRN conditions.<br>• Situations involving electronic warfare tactics (such as jamming, interference, and imitative deception).<br>• Situations involving nonhostile elements (such as civilians)." |

| Question | Answer | Doctrinal Reference/Rationale |
|---|---|---|
| 6 | A-3<br>B-1<br>C-4<br>D-2<br>E-6<br>F- 5 | FM 3-20.15, Chapter 3, pages 3-11 through 3-16 describe the six basic movement formations and the two stationary formations the platoon will use.<br><br>The **column** formation provides excellent control and fire to the flanks, but permits less fire to the front. It is used when speed is critical, when the platoon is moving through restricted terrain on a specific route, and/or when enemy contact is not likely.<br><br>The **staggered column** formation is a modified column formation with one section leading and one section trailing to provide overwatch. The staggered column permits good fire to the front and flanks. It is used when speed is critical, when there is a limited area for lateral dispersion, and/or when enemy contact is possible.<br><br>The **wedge** formation permits excellent firepower to the front and good firepower to the flanks. It is employed when the platoon is provided with overwatch by another element and is moving in open or rolling terrain. Depending on the platoon location within the company formation, the platoon leader and PSG (with wingmen) can switch sides of the formation.<br><br>The **echelon** formation permits excellent firepower to the front and to one flank. It is used to screen an exposed flank of the platoon or of a larger moving force.<br><br>The **vee** formation provides excellent protection and control, but limits fires to the front. This formation is used when terrain restricts movement or when overwatch within the platoon is required.<br><br>The **line** formation provides maximum firepower forward. It is used when the platoon crosses danger areas and is provided with overwatch by another element or when the platoon assaults enemy positions.<br><br>When it is operating independently, the platoon uses the **coil formation** to establish a perimeter defense during extended halts or lulls in combat. The lead vehicle will halt his vehicle in the direction of travel (12 o'clock) while the other vehicles position themselves to form a circular formation covering all suspected enemy avenues of approach.<br><br>The **herringbone** formation is used when the platoon must assume a hasty defense with 360-degree security while remaining postured to resume movement in the direction of travel. It is normally employed during scheduled or unscheduled halts in a road march. |

| Question | Answer | Doctrinal Reference/Rationale |
|---|---|---|
| 7 | A-2<br>B-1<br>C-3<br>D-5<br>E-7<br>F-6 | FM 3-20.15, Chapter 3, pages 3-25 through 3-36, paragraphs 3-103 – 3-120 describe the seven battle drills and the steps taken to accomplish each drill. Excerpts are presented below:<br><br>**Change of Formation Drill:** This drill is executed to accomplish a rapid change of formation in response to a change in terrain or enemy situation. The platoon leader must ensure that each TC knows the new formation and the relative position of each tank in the new formation.<br><br>**Contact Drill:** The contact drill enables the platoon to orient weapon systems and engage an enemy without changing its direction or speed of movement along the axis of advance. This drill is used when contact is made with small arms fire, non-armor-defeating weapons, or when the platoon sights the enemy without being engaged and does not want to stop or slow its movement.<br><br>**Action Drill:** The action drill permits the entire platoon to change direction rapidly in response to terrain conditions, obstacles, FRAGOs from the Commander, or enemy contact.<br><br>**React to Indirect Fire Drill:** When the platoon receives unexpected indirect fire, it moves out of the impact area, unless it is also engaged in direct fire contact or is directed to remain stationary. TCs place their hatches in the open protected position; other crewmen close their hatches.<br><br>**React to Air Attack Drill:** When the platoon observes high-performance aircraft, helicopters, or unmanned aircraft system (UAS) that could influence its mission, it initially takes passive air defense measures unless the situation requires immediate active measures. In a passive air defense, the platoon disperses or stops, to avoid detection altogether and/or to minimize the aircraft's target acquisition capability. The platoon also prepares for active air defense measures.<br><br>**React to a Nuclear Attack Drill:** When the platoon observes a brilliant flash of light and a mushroom-shaped cloud, crewmembers must act quickly to minimize the effects of a nuclear detonation.<br><br>**React to a Chemical/Biological Attack Drill:** The platoon initiates this drill during an operation whenever an automatic masking event occurs, the chemical agent alarm sounds, M8 detection paper indicates the presence of chemical agents, or a Soldier suspects the presence of chemical or biological agents. |
| 8 | C | FM 3-20.15, Chapter 3, page 3-20, paragraph 3-85 states, "There are no hard and fast rules for determining the superiority or inferiority of an enemy; the result is dependent on the situation. An inferior force is defined as an enemy element that the platoon can destroy while remaining postured to conduct further operations." |

| Question | Answer | Doctrinal Reference/Rationale |
|---|---|---|
| 9 | A<br>C | FM 3-20.15, Chapter 3, page 3-19, paragraph 3-76 states, "The commander's OPORD will assist the platoon leader in two ways. The most important thing the platoon leader must understand is the commander's intent. Understanding the commander's intent allows the platoon leader to execute without constant supervision and also in the event that the enemy situation changes during the mission. The commander's scheme of maneuver will direct the platoon leader in planning how to kill the templated or anticipated enemy force." |
| 10 | D | FM 3-20.15, Chapter 3, page 3-19, paragraph 3-84 states, "While the platoon deploys by executing a battle drill of occupying a covered and concealed position, the platoon leader must begin to evaluate and develop the situation. His primary focus is on determining and/or confirming the size (inferior or superior), composition (available weapon systems), activity, and orientation of the enemy force." |
| 11 | D | FM 3-20.15, Chapter 3, page 3-16, paragraph 3-67 states, "Overwatch is the tactical mission in which an element observes and provides direct fire support for a friendly moving element. Situational understanding is a crucial factor in all overwatch missions, whose objective is to prevent the enemy from surprising and engaging the moving unit." |
| 12 | B | FM 3-20.15, Chapter 3, page 3-22, paragraph 3-102, Figure 3-14B describes the actions the platoon should take. |
| 13 | D | FM 3-20.15, Chapter 3, page 3-22, paragraph 3-102, Figures 3-14C and 3-14D describe the actions the platoon should take. |

**Source:** FM 3-20.15, Tank Platoon, US Army, Feb 07

APPENDIX G

Student Feedback Questionnaire – End of Course (EOC)

Date: _____ PIN Number: _____ Course (circle one): 19D 19K

PE Methods You Used during the Course (record the number of times for each):

____ Terrain Board ____ VBS2 ____ DARWARS

Instructions: The questions below ask for your opinions about the instructional methods used during the practical exercises conducted *throughout the course*. While answering these questions, focus on the impact the method of instruction (terrain board or desktop gaming) had on training. Write-in comments, both positive and negative, are encouraged. Please use a separate sheet of paper if you need additional space.

| **1. During your practical exercises using terrain boards, how much do you agree or disagree that you as the Student were able to:** | Circle One for Each Item | | | | |
|---|---|---|---|---|---|
| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| a. Effectively understand all teaching points | 1 | 2 | 3 | 4 | 5 |
| b. Work in an environment for optimal learning | 1 | 2 | 3 | 4 | 5 |
| c. Work in a useful arena for tactical execution | 1 | 2 | 3 | 4 | 5 |
| d. Experience operational risks | 1 | 2 | 3 | 4 | 5 |
| e. See how to overcome operational risks | 1 | 2 | 3 | 4 | 5 |
| f. Effectively engage in making mission-critical decisions | 1 | 2 | 3 | 4 | 5 |
| g. Focus your attention on the "how" and "why" of the execution | 1 | 2 | 3 | 4 | 5 |
| h. Provide contributions and discussion | 1 | 2 | 3 | 4 | 5 |
| i. Visualize the battlefield | 1 | 2 | 3 | 4 | 5 |
| j. Experience a realistic command and control environment | 1 | 2 | 3 | 4 | 5 |
| k. Optimally role-play your assigned position | 1 | 2 | 3 | 4 | 5 |
| l. Receive coaching/instruction when needed | 1 | 2 | 3 | 4 | 5 |
| m. Work collaboratively with other students | 1 | 2 | 3 | 4 | 5 |
| n. Efficiently learn in the time allotted | 1 | 2 | 3 | 4 | 5 |
| o. Independently develop solutions | 1 | 2 | 3 | 4 | 5 |
| ***Comments and Suggestions:*** | | | | | |
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| **2. What problems did you encounter during the terrain board phases?** |
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| **3. Do you think there are limitations with using terrain boards to conduct the practical exercises? If so, please explain.** |
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| **4. What would you change to <u>improve</u> learning in the practical exercises?** |
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**Note: The remaining questions are only for students who used desktop games (VBS2, DARWARS) during training.**

| **5. During your practical exercises using <u>VBS2 and DARWARS</u>, how much do you agree or disagree that you as the <u>Student</u> were able to:** | Circle One for Each Item | | | | |
|---|---|---|---|---|---|
| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| a. Effectively understand all teaching points | 1 | 2 | 3 | 4 | 5 |
| b. Work in an environment for optimal learning | 1 | 2 | 3 | 4 | 5 |
| c. Work in a useful arena for tactical execution | 1 | 2 | 3 | 4 | 5 |
| d. Experience operational risks | 1 | 2 | 3 | 4 | 5 |
| e. See how to overcome operational risks | 1 | 2 | 3 | 4 | 5 |
| f. Effectively engage in making mission-critical decisions | 1 | 2 | 3 | 4 | 5 |
| g. Focus your attention on the “how” and “why” of the execution | 1 | 2 | 3 | 4 | 5 |
| h. Provide contributions and discussion | 1 | 2 | 3 | 4 | 5 |
| i. Visualize the battlefield | 1 | 2 | 3 | 4 | 5 |
| j. Experience a realistic command and control environment | 1 | 2 | 3 | 4 | 5 |
| k. Optimally role-play your assigned position | 1 | 2 | 3 | 4 | 5 |
| l. Receive coaching/instruction when needed | 1 | 2 | 3 | 4 | 5 |
| m. Work collaboratively with other students | 1 | 2 | 3 | 4 | 5 |
| n. Efficiently learn in the time allotted | 1 | 2 | 3 | 4 | 5 |
| o. Independently develop solutions | 1 | 2 | 3 | 4 | 5 |
| ***Comments and Suggestions:*** | | | | | |
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**6. Indicate the relative effectiveness of terrain board versus desktop game training.**
**(For each feature, circle the number that best corresponds to your opinion.)**

**a. Providing tactical realism:**

| Terrain Board | | | | | | | Difference | | | | | | | Desktop Gaming |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Please Explain:

**b. Causing students to become engaged:**

| Terrain Board | | | | | | | No Difference | | | | | | | Desktop Gaming |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Please Explain:

**c. Producing better student performance in CCTT exercises:**

| Terrain Board | | | | | | | No Difference | | | | | | | Desktop Gaming |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Please Explain:

**d. Enabling students to share knowledge and learn from each other's mistakes:**

| Terrain Board | | | | | | | No Difference | | | | | | | Desktop Gaming |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Please Explain:

**e. Stimulating realistic decision making:**

| Terrain Board | | | | | | | No Difference | | | | | | | Desktop Gaming |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| Please Explain: |
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**f. Prompting communication and teamwork skills:**

| Terrain Board | | | | | | | No Difference | | | | | | | Desktop Gaming |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| Please Explain: |
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| **7. Do you think there are limitations with using desktop gaming to conduct the practical exercises? If so, please explain.** |
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| **8. What problems did you encounter during the DARWARS or VBS2 phases?** |
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| **9. What are your <u>general impressions</u> of VBS2 training?** |
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| **10. What are the biggest <u>advantages</u> of VBS2 training over *terrain board* training?** |
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| **11. What are the biggest advantages of VBS2 training over DARWARS training?** |
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| **12. What are the biggest disadvantages of VBS2 training compared to terrain board training or DARWARS?** |
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| **13. How would you change VBS2 training to improve its effectiveness?** |
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**Thank you for your feedback!**